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ERRATA

Page 144, col. 1, line 5: For "*Ruga*" read "*Corium.*"
Page 205, col. 1, lines 17–18: For "Los Angeles" read "Palo Alto."
Page 325, col. 2, line 47: For "marked increase" read "marked local increase."
Page 326, col. 1, line 16: For "79 and 80°" read "78 and 79°."
Page 327, col. 2, line 35: For "east" read "west."

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MEDICINE.—*Andreas Vesalius.*[1] Howard W. Haggard, Yale University. (Communicated by William A. Dayton.)

We commemorate this year the 400th anniversary of the publication by Andreas Vesalius of a textbook on human anatomy. This recognition, however, is not in gratitude or respect for the anatomical facts that he set forth or for the benefit to humanity in his or subsequent centuries derived directly from the knowledge he gave of the structure of the human body. This gratitude and this recognition stem from a source far deeper and far more fundamental. Vesalius was one of that glorious group of revolutionary leaders whose conflicts were not with armies on the battlefield, not for territorial gains or national integrity, but for the fundamental right of men to see and hear and, seeing and hearing, to believe the evidence of their own eyes and their own ears. With his scalpel in the dissecting room he fought alone for the liberty of human thought. Anatomy was only symbolic: his field of endeavor might have been religion or philosophy—it might have been any field of learning. The weapons used by the great leaders who have given us the democracy of thought and the democracy of belief—who have given us intellectual independency and dignity—and the fields in which they used these weapons matter little; what do count are the battles they have won in a common cause. Do not view Vesalius as a man who added only to the store of human knowledge by telling us the structure of the body; view him primarily as one who helped to give us freedom of thought and opinion; do not view his *Fabrica* as an historical monument to anatomy; but view it as a monument to the struggle for truth.

These words of mine which I use for preface would, if they had been said to Vesalius, have sounded strange—grandiloquent—yes, they would have sounded silly to him. He was a simple and outspoken man who could not stomach intellectual dishonesty, who had breached the dignity of his own profession—and that profession was the lowest branch of medicine—breached it by pushing away the barber who, before the class in anatomy, did the mutilating dissection at the haughty direction of the professor who deigned to touch the body. Vesalius, I am certain, would never once have thought of himself as struggling for man's intellectual independence. I am equally certain that he did not imagine himself in a struggle of any greater magnitude than that, say, of convincing his teacher in Paris, Jacobus Sylvius, that he, Sylvius, did not know the true anatomy of the body and that he, Vesalius, did. If Vesalius had felt himself a hero, or had counted himself a fighter in a struggle above the level of the dissecting room, he would have shown an egotism that appears nowhere in his writings or his actions. It is we who, four centuries later, with the advantage of hindsight, can look back and give a value to his work that he and his contemporaries could not have given. To him and to them his one virtue was his correction of anatomical errors and the presentation of splendid anatomical illustrations. Today, there are far better anatomical textbooks than that of Vesalius, and his illustrations are now only artistic medical curiosities; da Vinci, years before, made drawings that

[1] Address delivered before the Washington Academy of Sciences, November 18, 1943. Received November 25, 1943.

were as good. As an anatomist, Vesalius is of mild historical interest; his *Fabrica*, as a specimen, is a fine book, but not a great book. His greatness and its greatness are not in their intended purposes and ends, but in their influence in breaking down a tradition that forced an unreality on human thought—not alone in anatomy but in all medical thought.

I have used the words "tradition that forced an unreality on medical thought." Let us now, before we turn to the life and work of Vesalius, examine something of the structure of that tradition.

As we view medicine over the long expanse of time, one fact stands out beyond all others: medical progress is rare. The usual state of medicine is one of stagnation and sterility in which, century after century, no new fact, no new application, is made; the essence of this stagnation and sterility has always been a philosophical concept that has, with its ready-made answers, stifled the curiosities of men, made them content with the knowledge they possessed in the belief that they held the ultimate answers. Medicine progresses only when there is dissatisfaction—when ignorance is admitted.

The first great sterilizing influence on medicine—one that held sway from prehistoric times—was that which combined medicine and religion. This combination was the inevitable result of the belief that diseases, indeed all the misfortunes of man, were due to supernatural influences exercised at the wills of spirits, gods, and demons. Under such a belief there was no incentive and no reason to seek the cause of disease since the cause was known. All that man could do was to devise better magic to influence the supernatural creatures or more clever tricks to outwit them. Under this belief man assumed no responsibility for his physical salvation; that responsibility was placed on the spirits or gods or demons who controlled his destiny and who held disease in their hands as a slave driver holds a whip.

This ancient tradition of primitive medicine was carried on into the early civilizations. The philosophy was not altered, dissatisfaction did not develop, and ignorance was not admitted. The alterations were all in the externals. The healing temple took the place of the tent or cave of earlier times; the priest took the place of the savage medicine man; and the crude and simple spirits that appealed to the savage mind were reincarnated as the regimented gods and demons and heroes whose names and lives are familiar to us from mythology.

The first break in this priestly healing, and consequently the first known period of medical progress, came in the classical period of Greece. Prior to this break, the Grecian medicine was in the hands of the priests of Aesculapius. The ministration to the ill was in the great and magnificent temples devoted to this god. In the statues to him there he was represented as carrying in his hand a staff about which twined a single snake that remains the emblem of the physician even to this day. Represented with him was his daughter whose name, Hygeia, has given us the English words "hygiene," "hygienic," and "hygienist." The name of his other daughter, Panacea, which now means a cure for all diseases, has never found a respectable place in modern medicine and, with the passage of our Federal food and drug laws, has diminished in repute even in the field of proprietary medicaments.

However rigid an impediment to medical progress, as we understand that progress, the Grecian healing religion may have been, the priests themselves were men of dignity and highest integrity. The code of their ethics has, like the caduceus of Aesculapius, come down to the physician of today; this code was incorporated in a temple oath; it later was called the oath of Hippocrates, and many a doctor of our day, on graduating from medical school, has sworn to this ancient oath.

The symbolism in emblem, word, and ethics is all that we have retained of this priestly medicine. But it was among its priests that modern medicine was founded. In the Age of Pericles, headed by a man—or he may have been only a name—Hippocrates, there developed the first scientific and progressive medicine of which we have any certain knowledge. Under this new medicine, man became responsible for his

own salvation on earth; his problems were capable of solution at his own hands; and he must seek the solution. Under this philosophy, which brushed aside the fatalism of spiritualistic medicine, there began the sound observation by which alone the physical nature of man could be discovered; by which the causes of his diseases could be found out and the remedies obtained. There was dissatisfaction with existing knowledge, there was frank confession of ignorance, and there was deep determination to obtain knowledge. And also there was intellectual freedom. No man was an authority so great that his word must be taken as the truth; instead, truth was to be found in the evidence of eyes and ears and touch and integrated with a clear and unbiased logic. This period was the great one of medicine; it stood out as a mountain peak, to whose heights men did not rise again for 18 or 19 centuries.

Under Roman conquest the descent began; and, with the Fall of Rome, it was complete. Men in later days, with the renewal of culture, could again have climbed up to the peaks of ancient greatness if the way had been open, but in those closing years of the Roman period, a barrier—the tradition which I mentioned earlier—was built across the way. This was the Galenic tradition. It was the tradition of authority. It was the second great obstacle to the progress of medicine, an obstacle that by ready-made answers stifled the curiosities of men in the belief that they held the ultimate answers; it closed their eyes and ears in the blind and deaf faith in authority.

The physician Galen, after whom this tradition is named, lived in the second century A.D. He was a man of great ability; he was the founder of experimental physiology, and to him are due basic discoveries in anatomy and diagnosis. But, unfortunately, he was also the most voluminous medical writer of ancient times—dangerous in itself and devastatingly so in this instance since Galen was also the greatest theorist and systematist. We know of 9 books on anatomy; 17 on physiology; 6 on pathology; 16 essays on the pulse and therapy; 3 books on temperament; and 30 on pharmacy. He differed from Hippocrates in that instead of simple observation and interpretation he followed a pragmatic system of medical philosophy. His postulates were based on the humoral ideas of Hippocrates, the Pythagorean theory of four elements, and his own invention of a spirit or "pneuma" permeating the body. Using these postulates with great ingenuity, he explained every phenomenon of health and disease in the light of pure theory. He had a mania for teleology, which he may have gotten from Aristotle whom he took as his authority. Aristotle had said that Nature makes nothing in vain—that is, every creature serves a purpose and is designed for that purpose.

Unquestionably structure follows function in the adaptation of any living creature to its environment. But it was not Galen's purpose to show the adaptation. Rather he sought to show that fitness to the environment was a manifestation of the goodness of the Creator. As Neuberger has put it: "Galen made his whole physiological theory a skillful and well-instructed special pleading for the cause of design in Nature, whereby he lost himself in *a priori* speculation in attempting to explain Nature's execution before even her mechanism had been demonstrated." And, as Garrison says: "He never really sought *how* an organ functions but in blind obedience to Aristotle he reiterated the transcendental *why* which Kant and Bernard have pronounced forever insoluble."

His ready-made answers, his polypragmatism, his reason for every phenomenon, his purposefulness, his monotheism and piety, his assumption of omniscience, all appealed to the Moslems who, for a time, carried the torch of learning; and they appealed also to the Church, which dominated the thought of Europe during the next 1300 years. Up to the time of Vesalius, everything in anatomy, physiology, diagnosis, therapy, and medical theory was referred to Galen as the final authority. It was an authority from which there could be no appeal. To deny it might, and did, lead to death for heresy. Thus the Galenic tradition of enforced authority was the barrier to medical progress; it was the barrier that was breached by Vesalius; and from this breaching the way was opened for modern

medical progress. From the days of Vesalius we date the second great period of medical advancement—the period in which you and I are fortunate to live, and to which many of us here owe our lives.

Whether Galen had made any dissections of the human body we shall never know. Probably he had not. At most he may have had an occasional glimpse at interior structures and some study of some human bones. The anatomy that he wrote of was that of the ox, the ape, and the hog. But in his writings this fact is not stated; it is man about whom he appears to be writing and to whom he gives a miscellaneous assortment of organs from the brutes. Man, according to Galen, had the abdominal muscles of an ape, a 4- or 5-lobed liver, seven segments in the sternum, and two bile ducts, and the female had a double-horned uterus. Galen further postulated minute pores in the septum which separates the right and left sides of the heart through which the blood was supposed to seep, and he found joint lines in the jaws where none were ever found afterward. These anatomical misfits and vagaries were, to keep an anatomical metaphor, the heel of Achilles in Galen's authoritative writings, and to them there was added, or subtracted as you will, by the scholastics of latter days, a difference in the ribs of man and woman dating from the birth of Eve.

These scholastics did not follow the simple and obvious procedure of running their fingers over the ribs to count them, but instead, in solemn discussion with ancient authority—not their own observations—as premises, they did gymnastics with logic. And from this exercise they derived the state of man's ribs, and they believed their conclusions as implicitly as they believed the teleology, of which they were indeed an integral part. Vesalius, in contrast, was one of those rude and practical people who outraged the ethics and formality of scholasticism by feeling and counting the ribs and believing what he felt and counted. The incredible blindness of scholasticism, the belief in authority rather than in fact, is summed up for me best in a statement attributed to a philosopher whose name I can not recall. He was being shown some structure of the body during an anatomical dissection; the structure differed from the authoritative description. His serious and considered statement in this dilemma was, in effect: "I should be inclined to believe the evidence of this demonstration if Aristotle had not stated specifically to the contrary."

It is difficult for us who have been emancipated in most matters from this type of thinking to realize what a hold it can have upon the human mind. But the freedom of our way of thinking is as cultivated a one as that of blind obeisance to authority. It is kept alive by continual cultivation. In a generation with other schooling we could revert to the subservience to authority and be willing to deny the evidence of our own eyes and ears. We see something of this in the political and racial views of a generation that has grown up today in Germany. We may call it fanaticism; in reality, however undesirable it seems to us, it may be a more natural and innate way of human behavior than is our democracy of thought.

Now in the days between Galen and Vesalius, there were anatomists of repute and there were anatomical dissections of a sort. But these anatomists, in the dissections they demonstrated, recorded nothing to controvert Galen; if some glaring inconsistency forced itself upon them, they brushed it aside with the statement that the body had changed since Galen described it.

When the first medical school was founded in Europe at Salerno, anatomy was taught, so we are told, from dissections of the hog. The restorer of human anatomy in medical education was Mondino of Bologna. In 1315, acting under royal authority, he gave a public demonstration of anatomical dissection with readings from Galen. In this, and in all subsequent dissections until the time of Vesalius, the medical student, the physician, and the professor did not do the dissecting. The spectators sat or stood in the dissecting room; the professor occupied a pulpit upon which rested the books of Galen; the subject for dissection was on a table in front and beneath this pulpit; the crude dissection was done by a barber with an instrument as large as a cleaver.

Mondino wrote a textbook of anatomy

which was issued in manuscript form in 1316 and was printed in 1478. It was the standard textbook in all Italian universities. It contained no new facts but was compiled from Galen and the Arabic commentators of Galen. In fact, much of the nomenclature was Arabic. According to his description, the heart was in the center of the body. The valves were, to quote, "a wonderful work of Nature," but beyond this pious exclamation of admiration there was no description of their function. The blood, according to the observations of Mondino, followed precisely the course described by Galen in that it passed through the septum between the right and left side. He says: "To the end that the blood which comes to the left ventricle from the right, be refined, because its refinement is the preparation for the generation of vital spirit." I use this quotation because this question of the movement of the blood was one of the major points at which the demonstrations of Vesalius broke the Galenic tradition. When he showed that the blood did not pass through the septum, this finding could not be dismissed on the ground of an anatomical variation or of an alteration in structure since the days of Galen. The passage was basic to Galen's whole concept of physiology. Destroying this basis cast doubt not only on Galen's anatomical observations but, far more important, it cast doubt upon his whole thesis of function. The structures of the body might vary; it was obvious that they did in gross anatomy as between different men; similarly, they might have altered since the days of Galen. But it was inconceivable that fundamental physiology varied or that it had altered since Galen. The structure was only the building that housed the microcosmos; function—the operation within—had a more fundamental significance.

The anatomists who worked between the time of Mondino and Vesalius added some details to the knowledge of bodily structure but none disagreed with Galen. That is, none if we except Leonardo da Vinci. He believed that a knowledge of artistic anatomy could be gained only at the dissecting table. He probably knew Galenic anatomy and that of Mondino, but he was his own teacher. He left more than 750 sketches of bodily structures, strikingly accurate and magnificently presented. He was the first creative anatomist, but he had no influence on the Galenic tradition. He recorded his marginal notes in the secretive spirit of the times in minor writings. When Vesalius published his *Fabrica*, and for two centuries afterward, Leonardo's drawings were lying unpublished, first as the cherished possession of his favorite pupil Melzi, later in the Ambrosian Library at Milan, and still later forgotten in the Royal Library at Windsor.

There is one other student of anatomy to mention before I come to Vesalius. He is Albrecht Dürer. He did nothing to shake the Galenic tradition, but in his publication on human proportions he made the first attempt to represent shades and shadows in woodcuts by means of crosshatching. This, in turn, may have had an influence—and this is speculation—upon the work of Titan's pupil van Calcar, who made the magnificent wood engravings for the *Fabrica* of Vesalius.

Now as to the man himself. Andreas Vesalius was born in 1514 under the name of Wesalius; the V was substituted for the W in the family name in 1537. Three weasels were prominently displayed on the coat of arms of the family, suggesting that previously the family name, which was Whiting, had been changed to that of the locality that the family claimed as its native place —Wesel in the Duchy of Cleves. In the family there was a long line of prominent physicians who practiced in the courts of the period or taught in the universities. Andreas's father was, throughout his life, apothecary to Charles V and to Margaret of Austria. I mention this court connection because it was the father who, on Andreas's early retirement from anatomy, obtained for him a place in the court of the Emperor.

And finally, we know from astronomical observations made by Jerome Cardan that Andreas was born at 6 o'clock in the morning and under favorable stellar influences. As a youngster he was sent to the University of Louvain, which then was second in number of students only to that of Paris. Here Andreas obtained an extensive training in Greek and Latin, learned much of Arabic, and something of Hebrew. But tir-

ing of these dialectics, he, for reasons we do not know, turned to the study of anatomy. The writings of the church fathers, as approved of in the highly orthodox university, gave him little substance for the study. For an independent, searching mind no satisfying anatomical knowledge could be gleaned from Albertus Magnus and Michael Scotus. And we are told by his contemporaries that he soon discovered that the only true text of anatomy was the opened body. We are told further that he dissected, as has many an inquisitive boy, the bodies of mice, moles, rats, dogs, and cats.

In 1533, at the age of 19, he went to the Mecca of all medical students—Paris. The most notable feature of the medical education at Paris was that it had successfully removed the errors which the works of Galen had suffered at the hands of the Arabic translators. Paris taught pure Galen and taught it with a fervor for the orthodox as great as any theological institution of the period. Of the teachers of great repute whom he met in Paris, I mention only one because of the conflict that arose later. That one was Jacques Dubois, better known as Jacobus Sylvius. He was noted for his industry, his eloquence, his command of abusive language, and, above all, for his avarice. The last of these qualities is testified to by his epitaph, which reads:

SYLVIUS LIES HERE, WHO NEVER GAVE
ANYTHING FOR NOTHING:
BEING DEAD, HE EVEN GRIEVES THAT
YOU READ THESE LINES FOR NOTHING.

Sylvius started out in life as a philologist, but his desire for wealth led him to abandon this field and take up medicine. Before he had obtained a degree, he began a course of medical lectures explanatory of Galen and was so successful that the University of Paris protested. Consequently, in 1529 at the age of about 50, he went to Montpellier and obtained his degree. Returning again to Paris be became a free-lance teacher and again with such effect on university attendance that the authorities ruled that he must once more stop since, so it seemed, he had failed to obtain a bachelor's degree before his doctor's degree. He took two years off to satisfy this requirement and then, since there could be no further legitimate protest, he emptied the benches at the university as the students flocked to his eloquence. Sylvius died in 1555 and, to save funeral expenses, was interred in the paupers' cemetery. I have read his epitaph.

In justice to Sylvius it should be said that he was the first professor in France who taught anatomy from human dissection. But it was dissection after the method of Mondino. Never did Galen have a more devout follower than Sylvius. He declared that: "Galen's anatomy was infallible, that his physiology was divine; and that further progress was impossible." And Sylvius, with his great learning and equally great command of abusive language, was no man to be questioned by the 19-year-old Vesalius, who listened to his lectures and watched with distress as the barber mangled the anatomical specimen. It is said that in sheer desperation the young student sometimes pushed away the prosectors, took the knife in his own hands, and carried out a systematic dissection. Recognition was given to his ability by one of his teachers, Guinter, who said of two of his students: "First, Andreas Vesalius, a young man, by Hercules, of singular zeal in the study of anatomy; and second, Michael Servede, deeply imbued with learning of every kind, and behind none in his knowledge of the Galenic doctrine." As to Michael, there was never a more ironic word than that of his devotion to Galen; he was the Michael Servetus who later, in showing an error of Galen, antedated Harvey in postulating the circulation of the blood and who, for a theological quibble, was burned at the stake by order of Calvin and whose books were burned with him. Vesalius succeeded by good fortune where Servetus failed.

In Paris, Vesalius made numerous dissections and he became a master of the bones of the body. This latter knowledge was not gained from his professors but in the cemeteries, where, as in the grave digger's scene in *Hamlet*, with the crude burials of the times, bones often found their way to the surface.

In 1536—after he had been in Paris three years—the Franco-German War broke out and Vesalius went to the University of

Louvain. Soon after his arrival he obtained the famous skeleton whose theft is always portrayed as the dramatic episode of his life. At Paris he had searched for bones in the cemeteries; in Louvain he visited the gallows outside the city walls and searched on the ground. It was there that he found, not on the ground but on the gallows, a skeleton that was held together by the ligaments and that still possessed the origin and insertion of the muscles. It is said to have been the skeleton of a famous robber who had been roasted to death and then picked clean by the birds. There, above the eyes of the young anatomist, was what he had never seen before, a complete and articulated human skeleton. In the past he had tried to make one by piecing together the bones from many skeletons, gathered from different places but this was a prize, He climbed the gallows, stole the skeleton, and carried it home. One finger, a knee cap, and a foot were missing. Again, at night, he stole out of the city and searched among the decaying bodies until he found the missing bones.

Such dangerous and secret expeditions as this soon became unnecessary, for the burgomaster of Louvain agreed to furnish Vesalius and his students with anatomical material. It was from Louvain that he began his career as an author but not on anatomy; he published a translation of an Arabic work on general medicine. He conducted public demonstrations of anatomy, but some remark of his concerning the seat of the soul caused theological criticism and threat of formal charges. This threat brought caution, and caution brought dissatisfaction. He left Louvain and, in 1537, traveled to Venice.

Here the study of anatomy was actually encouraged by the Theatin monks, who devoted their lives to the care of the ill. At the head of this order was a young man of great strength of character and vision, Ignatius Loyola, who was to become the founder of the Jesuit order, which was accepted by the Pope in the same years that Vesalius published his *Fabrica.* Another fortunate meeting for the young anatomist was with his countryman Jan Stephen van Calcar, student of Titian who was to make the drawings for the *Fabrica.* In December of the same year that he reached Venice, 1537, Vesalius received his degree of doctor of medicine and almost simultaneously was appointed professor of surgery with the right to teach anatomy in the University of Padua.

From manuscripts of the period we have a fairly clear idea of the way in which he taught. The meetings of his classes were in a wooden amphitheater, which accommodated about 500 spectators. Those who attended were not only medical students but also distinguished citizens interested in the science of the times. The course occupied the full day from early morning until evening for a period of three weeks. During this entire time, Vesalius lectured, drew diagrams, and, with the aid of students, made magnificent dissections. No barber helped him. He opened the book and turned the pages, as it were, of the body himself. We have a description of the course he gave in December, 1537. Every seat in the amphitheater was taken, and all standing room was occupied. The professors of the university, officials of Padua, members of the clergy and learned persons of all ranks and positions were there. The crowd extended to the very edges of the dissecting table. Vesalius—then at the age of 23—entered. He made a few remarks as to the general importance of anatomy. Then, by means of a dog or a sheep, he demonstrated the division of the body, the joints, and several sorts of flesh, or what today are called tissues. Next, he turned to the human cadaver and discussed the changes of age and the differences of sex. Then came the dissection, and with each succeeding day there followed a continual demonstration with sketches and pertinent discussion of all collateral medical, physiological, and pathological matters. Such was the success of his courses that in 1539 and 1540 he was called from Padua to Bologna to conduct public dissections. Bologna was the ancient home of Mondino, who, as you will recall, had revived the practice of teaching human anatomy. In Bologna a special amphitheater was erected for the dissections by Vesalius.

In his lectures he could not escape disputations, for the errors of Galen were laid

bare before the audience. Vesalius gave all such disputations a close anatomical basis and avoided all discussion of theoretical physiology. We have an example of this later from the *Fabrica*. There, touching upon Galen's basic theory that the blood passed from the right side to the left side of the heart through pores in the septum, Vesalius says: "We are driven to wonder at the handiwork of the Almighty, by means of which the blood sweats from the right into the left ventricle through passages which escape the human vision." As one of his spectators, you could, in pious faith, accept that on its face value or, as a skeptic, you could read into it what significance you wished.

The culmination of the career of Vesalius at Padua was the publication, in 1543, of the *Fabrica*. It was the result of three years of grueling work and no less of constant vexation with his friend the artist van Calcar, who made the woodcuts. These and the text were taken over the mountains in the summer of 1542 by a merchant named Danoni, who delivered them to the printer, Oporinus, at Basel. With them there was an explanatory letter from Vesalius giving minute details of the way in which he wanted the book printed. Oporinus at once set about having the type cast and the pages composed and printed. In those days the printer was a scholar, and with him there was a group of scholars; he and they took over the task not only of printing but of revising, editing, and rewriting the manuscripts. Early in 1543, however, Vesalius himself came to Basel and followed the book to completion.

It has been suggested in the past that it was Titian himself who made the sketches for the woodcuts. This belief led, in the years following the publication of the *Fabrica*, to its especially high esteem among artists. At the time the woodcuts were made, Titian was over 60 and, although still vigorous, he was too busy and too honored in his established field to undertake the drawings for a youthful anatomist in Padua. Vesalius did not sign the name of the artist in the *Fabrica*, but increasing evidence points to van Calcar. It was he who, in 1538, made the cuts for certain anatomical sheets which Vesalius issued for his students. The drawings are essentially the same as those in the *Fabrica*, as vividly executed and as detailed.

In the *Fabrica*, the drawings vary considerably in merit. Those of the skeleton and of the muscles are the best. Those of the nervous system are of much less merit.

The *Fabrica* consisted of 659 folio pages of text: 34 pages of index; 6 pages of preface; and 2 pages of a letter to the printer, Oporinus.

From our standpoint, there were many unavoidable errors in the anatomical descriptions in the *Fabrica*. As Vesalius maintained—and soundly so—function can be determined only from structure; and therefore it is useless to speculate as to function until the structure is known. But even his eyes were occasionally blinded by those theories of function which he believed were facts. He did not know of the circulation of the blood but assumed, without apparent question, that the blood ebbed and flowed in the veins. Hence the anatomical significance of the valves which he saw in the veins escaped him completely. He considered them mere excrescences that fortunately did not interfere with the flow of blood in either direction.

But such features are carping criticisms. The main point is that Galen had been wrong. Not wrong in details as Vesalius was occasionally, but wrong in plainly observable facts and in easily demonstrable facts. The *Fabrica* was a denial of Galen. The reader could believe Vesalius and his own eyes and ears; or he could close his eyes and ears and believe Galen. The *Fabrica* forced the issue. And if the reader believed Vesalius and his own senses in anatomy, doubt was cast upon all the interlocking system of Galenic medicine.

What is more, the issue now was not before a few interested and sympathetic spectators in an anatomical amphitheater but before the whole world. The *Fabrica* was for all men to read.

If the physician believed Vesalius, then he was forced to throw aside much that he had believed and taught and to stop the veneration of one who, throughout his whole education had been held before him

as the authority—to discredit the saint, the prophet, the dictator of medicine. Men do not easily change so radically in matters that would touch them deeply, that would shake them from the mental security of an orderly and satisfying system of beliefs. The intellectual labor of making the change bewilders them. To discard what they have believed and to follow the teachings of another touch upon their egos. Their emotions rise; and the height of the rise is often an indication of depth to which the instrument has probed their convictions. Sylvius, the teacher at Paris, he of the vituperative tongue, was a leader in the opposition. He spoke of Vesalius as Vesanus (a mad man) whose pestilential breath poisoned Europe.

It is from conflict that views are altered. It is only in conflict that sides are taken, that wide interest is aroused. This conflict was essentially an election; men were making their speeches, as it were, for the candidate of truth: Vesalius vs. Galen. And what was most important, many anatomists decided to settle the choice, not by disputation, but by recourse to dissection.

It was in the midst of this struggle that he had precipitated that Vesalius returned to Padua from his year's absence. Padua was seething with the controversy. Some of his own pupils turned against him. The arguments were bitter and personal. Vesalius was a strong fighter, but he was first and foremost an observer and a student. Why should he waste his time in arguing over the existence of what any fool could see with his own eyes? He was disgusted. He went to Pisa in 1544 and conducted a course in anatomy. He declined the chair in that university offered him by the Medici. He was tired of the continuing controversy —sick of disputes and of persecution by members of his own profession. How could he study anatomy when interest was only in him as the center of a storm and in his efforts at defense? In a fit of passion he, at the age of 30, threw his manuscripts into the fire. This gesture ended his career as a scientist. He accepted an appointment as physician to Emperor Charles V of Spain. Gabriel Fallopius, formerly professor at Pisa, and a pupil of Vesalius, was appointed at Padua to succeed Vesalius. Fallopius studied anatomy undisturbed by the storm that still raged about his predecessor. Vesalius was a court physician; his reputation as a physician grew great in Madrid but only in Madrid. The scalpel with which he had made his dissections grew rusty while he treated the maladies of the ladies and gentlemen of the court.

Then in 1561, when he had been 17 years away from Padua, he received a book by Fallopius—a book of anatomical observations. It was a complete confirmation of his work. The battle was won. In Padua, in the world outside of Spain, one could now speak freely against the anatomy of Galen; one could use eyes and ears and believe what one saw and heard. It was now Fallopius who led in anatomy—already men were forgetting Vesalius. That little dart of inescapable bitterness that any human being would have, even amid his rejoicing at the acceptance of his work, is stated deftly by Edith Wharton in her poem "Vesalius in Zante":

> Vesalius? Who's Vesalius? This Fallopius
> It is who dragged the Galen idol down
> Who rent the veil of flesh and forced a way
> Into the secret fortalice of life.

Then, in 1563, Vesalius made a pilgrimage to Jerusalem. The reason is not known. Perhaps it was the restlessness that grew out of reading Fallopius and the fact that Fallopius had died and the chair at Padua was vacant. It may have been a dozen reasons, for Vesalius was an impetuous man. There is a legend—and I have grave suspicions of all legends of medical history—that rests on a letter written in 1565 between two physicians of that period. It says: "Doubtless you have heard that he went to Jerusalem. The journey had, they tell us from Spain, an odd reason. Vesalius, believing a young Spanish nobleman whom he had attended to be dead, obtained leave from the parents to open the body for the sake of inquiring into the cause of the illness which he did not rightly comprehend. This was granted; but he had no sooner made an incision into the body than he perceived the symptoms of life, and opening the breast saw the heart beat. The parents coming afterwards to the knowledge of this, were not satisfied with prosecuting him for

murder, but accused him to the Inquisition of impiety, in hope that he would be punished with greater rigor by the judges of that tribunal than by those of the common law. But the King of Spain interfered, and saved him on condition that by way of atoning for the error he should undertake a pilgrimage to the Holy Lands." Edith Wharton has put it thus:

This pilgrimage
They call a penance—let them call it that;
I set my face to the East to shrive my soul
Of mortal sin? So be it. If my blade
Once questioned living flesh, if once I tore
The pages of the Book in opening it,
See what the torn page yielded ere the light
Had paled its buried characters—and judge!

Whatever the cause may have been, he made the pilgrimage. That was a year, as I said, after the death of Fallopius at Padua and the chair of anatomy was vacant. Perhaps this may have been the cause of the journey. If it was, it bore fruit, but fruit that was never eaten. In the Holy Land, Vesalius received an invitation to resume his old chair at Padua. He shipped for home. A violent storm swept the Ionian Sea, his boat was wrecked on the Island of Zante. There, of a sudden and obscure malady, he died. He died—the author of the *Fabrica*, which Osler says was "the greatest book ever written, from which modern medicine dates."

ECONOMICS.—*Comparison of two methods of estimating capitalized value of earning capacity.*[1] A. J. Lotka, New York, N. Y.

Estimates of the capitalized value of human earning capacity have been made by two different methods. It is rather singular that no examination has ever been made of the relation between these two methods.

The first method, dating back to William Petty,[2] computes the capital C which, invested at an interest rate i, would yield the total annual earnings E of the population, and then regards

$$C=\frac{E}{i} \qquad (1)$$

as the capital value of the population of N persons (of all ages and both sexes) or C/N as the average value per head of the population.

The second method, developed by William Farr,[3] equates the capital value *of a wage-earner* to the present worth of his net future earnings (i.e., earnings less expense for his own personal maintenance). Denoting the value thus defined by V_a for a wage-earner of age a, Farr's method, expressed in an algebraic formula, gives

$$V_a=\frac{l_0}{l_a v^a}\sum_a^\omega L_x W_x v^{x+1/2} \qquad (2)$$

where W_x denotes the earner's *net* annual earnings at age x to $x+1$ and $v=1/(1+i)$ is the annual discounting factor to reduce future receipts to their present worth at age x. The symbol l_x, with its usual significance, denotes the number of survivors to age x out of l_0 born (age zero), and L_x is the number of persons of ages x to $x+1$ in a "life table population," so that within linear approximation $L_x=(l_x+l_{x+1})/2$. The symbol ω denotes the limiting age of life. Since l_0 is a purely arbitrary constant (the *radix* of the life table), we can arbitrarily put $l_0=1$. Then l_x and L_x, instead of numbers of individuals, represent corresponding proportions. It will simplify our formulae to adopt this convention.

It is at once obvious that Petty's and Farr's estimates can not be quite generally equivalent, since the total value of the population, in the sense of Petty's estimate, must depend on the age distribution, as must also the value per head deduced from it; whereas Farr's estimate of the value of the individual earner does not involve the age distribution of the population, as it applies specifically to an individual of given age.

[1] Received October 16, 1943.

[2] Petty, Sir William, *Political arithmetic, or a Discourse concerning the extent and value of lands, people, buildings, etc.*, p. 192. 1699.

[3] Farr, William. Journ. Stat. Soc. London, 1853, p. 43.

The question, however, arises how Farr's estimate, applied to a natural standard population, compares with Petty's applied to the same. Such a natural standard is presented in a so-called life table population, that is, a stationary population maintained, with constant annual births B and an equal number of annual deaths D, under the regime of a fixed life table.

In the stationary population the number of individuals between the ages x and $x+dx$ evidently is $Bl_x dx$. If w_x denotes the average annual earnings at age x per head of the population of both sexes and of age x, then the total earnings of the population will be

$$E=B\int_0^\omega l_x w_x dx \tag{3}$$

or, in linear approximation

$$E=B\sum_0^\omega L_x W_x \tag{4}$$

where

$$W_x=\frac{w_x+w_{x+1}}{2} \tag{5}$$

According to Petty the capital value of the population would thus be

$$C=\frac{B\sum_0^\omega L_x W_x}{i} \tag{6}$$

with W_x in this case referring to *gross* earnings.

On the other hand, if V_x is the average value of an individual of age x, in the sense of Farr (but averaged over all occupations, including unemployed, and both sexes) then the sum[4] of these values for all the individuals of the population is

$$C'=B\int_0^\omega l_x V_x dx \tag{7}$$

or, in linear approximation (trapezoid formula)

$$C'=B\left\{\sum_0^\omega l_x V_x-\tfrac{1}{2}l_0 V_0\right\} \tag{8}$$

and hence, introducing (2), with $l_0=1$,

$$C'=B\left\{\sum_0^\omega \frac{1}{v^a}\sum_a^\omega L_x W_x v^{x+1/2} - \frac{1}{2}\sum_0^\omega L_x W_x v^{x+1/2}\right\} \tag{9}$$

$$=B\left\{\sum_0^\omega L_x W_x v^{x+1/2}\sum_0^x \frac{1}{v^a} - \frac{1}{2}\sum_0^\omega L_x W_x v^{x+1/2}\right\} \tag{10}$$

$$=B\left\{\sum_0^\omega L_x W_x \frac{v^{-1/2}-v^{x+1/2}}{i} - \frac{1}{2}\sum_0^\omega L_x W_x v^{x+1/2}\right\} \tag{11}$$

Omitting terms of second degree in the expansion of $v^{-1/2}=(1+i)^{1/2}$, that is, putting $v^{-1/2}=1+i/2$ this gives

$$C'=\frac{B\left(1+\frac{i}{2}\right)}{i}\left\{\sum_0^\omega L_x W_x - \sum_0^\omega L_x W_x v^{x+1/2}\right\} \tag{12}$$

or finally, putting

$$\delta=\frac{i}{1+\frac{i}{2}}=\frac{2i}{2+i} \tag{13}$$

$$C'=\frac{B\left\{\sum_0^\omega L_x W_x-\sum_0^\omega L_x W_x v^{x+1/2}\right\}}{\delta} \tag{14}$$

where δ is (in linear approximation) the instantaneous rate of interest corresponding to an annual rate i. Petty's procedure for the same stationary population gives

$$C=\frac{E}{i}=\frac{B}{i}\sum_0^\omega L_x W_x \tag{15}$$

Thus, even in the simple case of a stationary (life table) population, Farr's pro-

[4] We may form this sum in a purely arithmetical sense, without committing ourselves to any physical interpretation; that is, without enquiring in what physical sense, if any, "Farr Values" may be additive.

cedure leads to a result at variance with that of Petty. The nature of the difference calls for examination.

The points of difference fall into two categories. Those of the first reside merely in the kind of data to which the procedures have been applied, namely:

Petty starts from a total *gross* income of a population, and obtains a per capita average for the entire population of all ages and both sexes by dividing by the number of the population.

Farr applies his procedure to the *net* income of individuals *of a specified earning capacity.*

The procedure can, however, be applied equally to the corresponding *gross* income, and this has actually been the plan adopted by A. Barriol.[5] Conversely, if the data were available, Petty's method could be applied to *net* income.

Also, it would be possible to apply Farr's procedure to an average individual representative of all earning capacities and of the two sexes jointly. We shall, in what follows, assume that this is done, and that formula (2) is construed accordingly with reference to net earnings.

Petty's indirect estimate of the earnings of the population as the excess of the total income over the income from property is questionable. Aside from numerical inaccuracies in the data, this method involves an error in principle. The earnings of a man can not be considered apart from the earnings of the capital invested in his inanimate aids to production. The two form one operating unit, and its performance can not be summed up by the mere addition of two items, one for the human labor, and one for the contribution of the machine, plant, etc. Even the contributions of the several parts of a plant are clearly not additive. The productive performance of a motor plus machine tool is not the sum of the performance of the motor alone—this would be zero—plus that of the machine tool alone—this also would be zero. In the same way the productive performance of manufacturing plant without human operators would be zero, and the productive performance of the human operators without the plant, though not necessarily zero, would in the majority of cases be relatively very small. The performance of man plus plant is far from being merely the sum of the performance of man alone plus that of plant alone.

These, then, are incidental differences, which, in principle at least, could in part be removed by suitable selection of data.

There remain three fundamental differences, not arising merely from the nature of the data, but representing inherent defects of Petty's method:

1. Petty's method gives at best an average value per individual of the particular population (having a certain distribution by sex, age and earning capacity) as against Farr's method, which evaluates the individual according to age, the values so obtained being then in turn applicable to any population.

2. Petty's formula as applied to a life table population lacks the term $-B\sum_0^\omega L_x W_x v^{x+1/2}$. He has treated the capital value of the population as a perpetuity, overlooking the fact that actually the population suffers a constant drain through deaths, which, in a stationary population, is replaced by the values of incoming new births.

3. A minor correction to apply to Petty's formula is the introduction of the instantaneous interest rate δ in place of the common interest rate i, to allow for the fact that, regarded as an income-yielding capital, the population brings a continuous income, unlike a loan of money, which brings an income at finite intervals.

These results can be generalized somewhat. Still considering the case of a population with fixed life table and age-specific earning capacity, but with variable annual births (and consequently deaths) let us denote by $B(t-x)$ the annual births at time $t-x$, so that at time t the number of persons of ages x to $x+dx$ will be $B(t-x)l_x dx$. Then, using the instantaneous interest rate δ, the Farr value of the population will be

[5] Revue Économique Internationale, Dec. 1910; March 1911.

$$C' = \int_0^\omega e^{\delta a} \int_a^\omega B(t-x)l_x w_x e^{-\delta x} da dx \quad (16)$$

$$= \int_0^\omega B(t-x)l_x w_x e^{-\delta x} \int_0^x e^{\delta a} dx da \quad (17)$$

$$= \frac{\int_0^\omega B(t-x)l_x w_x dx - \int_0^\omega B(t-x)l_x w_x e^{-\delta x} dx}{\delta} \quad (18)$$

Petty's procedure in analogous application would give

$$C = \frac{\int_0^\omega B(t-x)l_x w_x dx}{\delta}, \quad (19)$$

which lacks the second term of the result given by Farr's procedure.

PALEONTOLOGY.—Cribanocrinus, *a new rhodocrinoid genus.*[1] EDWIN KIRK, U. S. Geological Survey.

The genus *Rhodocrinus*, in common with other early crinoid genera, has had a great number of diverse forms referred to it. Several genera have been separated from this amorphous assemblage in the past. It is here proposed to erect another genus, *Cribanocrinus*, for the reception of a fairly homogeneous group of species from the lower Mississippian.

Cribanocrinus, n. g.

Synonym.—*Rhodocrinus* (in part of authors).
Genotype.—*Rhodocrinus wortheni* Hall.

Theca. Dorsal cup typically subglobose to urceolate or ovate. Base flattened, depressed or with a well-defined central invagination. Maximum diameter of cup usually at about one-half its height, or lower. The cup contracts distad, having its least diameter at the level of the arm bases. The tegmen is very small, convex, and made up of small plates. The anal opening is at the apex of a relatively small protuberance that can scarcely be dignified by the term anal tube. This protuberance is seldom preserved, and its base may be marginal at nearly the level of the arm bases, or excentric on the tegmen. Owing to the reduced diameter of the cup at the level of the arm bases, the arm groups are closely spaced. They are somewhat more widely separated in the posterior interradius than elsewhere.

Typically the surface of the plates is smooth, except for the customary fine granulation. The plates are convex, becoming tumid in such species as *C. whitei*. In some species there is a low, inconspicuous rounded ridge traversing the radials and brachial series within the cup. In the later species of the Keokuk, Borden, and Warsaw there is a variable development of surface ornamentation consisting of low radiating ridges or irregular rugosities.

IBB. Usually entirely enclosed within the basal pit and concealed by the column. In forms with slight invagination, such as *C. wortheni*, they extend beyond the column.

BB. Very large, may be larger than or somewhat smaller than the *RR*. In the majority of the species the proximal portions of the *BB* are flexed inward, forming the wall of the basal pit.

RR. Large.

IBrr. The first *IBr* is typically quadrangular but may be pentagonal, hexagonal, or even heptagonal. It is relatively small. *IAx* is small and may be either somewhat smaller or larger than IBr_1. In most of the species, even in individuals of maximum size, there is but a single *IIBr* incorporated in the cup. The number of incorporated *IIBrr* apparently does not exceed two in any case.

IRR. The interradial fields are narrow at the base, widen distad, and then narrow. The posterior interradius is appreciably larger than the others. The first interbrachials in all cases rest on the truncated distal faces of the *BB*. Exceptionally in very large specimens, and particularly in *C. wachsmuthi*, two interbrachials may rest on the *post B*. In such cases the second plate appears to be a lateral plate of the second range that has migrated downward within the lifetime of the individual. Usually

[1] Published by permission of the Director, U. S. Geological Survey. Received October 25, 1943.

there are three plates in the second range in the *post IR* and two in the others. Occasionally there is a poorly defined median row of plates in the *post IR*, but this is exceptional. In the other interradii one commonly finds two plates in each range above the second, the increasing and diminishing width of the interradius being compensated for by increased size of the plates rather than the presence of additional interbrachials. At the level of the arm bases the interradial field is narrow, and in some cases is little wider than the space between the arm bases within a radius. No intersecundibrachs have been seen in any species referred to the genus.

Arms. The arms are relatively short and stout, tapering rapidly distad. They are uniserial below and compactly biserial above the bifurcations. The branching of the arms is somewhat variable but falls within a well-defined pattern. The first division of the free arms takes place on the sixth to tenth secundibrach, the number varying even as between the halves of a ray. Several species consistently hold this number of 20 rami. In other species there may be additional bifurcations. One or more of the rami may divide in an arm group, and in some species all do so, giving a maximum of 40 rami. In an occasional radius, in the Kinderhook species, there may be but two rami.

Column. The column is relatively stout, circular in section, and has a small pentagonal lumen.

Geologic and stratigraphic distribution.—The described species of *Cribanocrinus* are found in the Kinderhook, Burlington, Keokuk, and Warsaw of the Mississippi Valley and the Borden of Indiana. It is probable that some European species fall within the genus.

Relationships.—*Rhodocrinus*, as is the case with several of the early crinoid genera, has a very doubtful nomenclatorial status. For the purposes of this paper I treat *Rhodocrinus* according to currently accepted usage, that is, with the type species *verus* based on Miller's (1821) plate 1, figure 2 (opposite p. 107). That this usage may not be valid is admitted. The validation of *Rhodocrinus verus* as based on the specimen indicated will require a ruling from the International Commission of Zoological Nomenclature, if and when that body again functions.

The dorsal cup of typical *Rhodocrinus* has a flattened base. The sides of the cup are nearly vertical, or diverge distad. There may be a slight constriction at the level of the lower fixed brachials and an outward flare above. There are typically three or more secundibrachs incorporated in the cup and intersecundibrachs are present. The interbrachial fields are wide and merge distad into the tegmen. The radials and incorporated brachial series are traversed by strong, rounded ridges, and the interbrachial fields are somewhat flattened, giving the cup a definite pentagonal cross section. Passing from plate to plate throughout the cup are rounded ridges. As viewed from below, one sees a well-defined stellate pattern, formed by these ridges. The tegmen, as seen in an English species nearly allied to the type, is low, with depressed interambulacral areas. As viewed from above, the theca appears definitely lobate.

There are a number of characters in which *Cribanocrinus* differs from *Rhodocrinus*. The lack of ornamentation in the typical group of species of *Cribanocrinus* or its slight development in the later species is one of the most striking differences. The rounded subglobose to ovate cup of *Cribanocrinus* and its constriction at the level of the arm bases is perhaps the most important difference. Stemming from this are: the narrow interbrachial fields, all but cut off from the tegmen; the tegmen greatly reduced in size; and the relatively great size of the basals and radials as compared with the primibrachs. The incorporation of but one or two *IIBrr* in the cup and the concomitant lack of intersecundibrachs in *Cribanocrinus* are likewise important, although, of course, in very young individuals of *Rhodocrinus* the same conditions would obtain.

In the Kinderhook is a group of species that may be referred to *Rhodocrinus*, such as *nanus*, *kirbyi*, and *cavanaughi*. Such strongly ornamented forms, which have other *Rhodocrinus* characters as well, do not pass up into the Burlington, so far as known. No one can doubt the close relationship of the Kinderhook species of *Rhodocrinus* and *Cribanocrinus*, and that they had a common Devonian ancestor. In the Kinderhook species of *Cribanocrinus*, *C. watersianus*, and in the species from that horizon identified as *wortheni* the cup has a subpenta-

gonal cross section. In the earlier species of a genus where much material is available, the reference of a given form to one genus or a closely allied one is always more or less arbitrary. In later phylogeny, when the generic characters become well established, there is, of course, little difficulty.

Remarks.—Specimens of *Cribanocrinus* are very rare. This is probably not due to the fact that they were uncommon in the Mississippian seas. Rather, the thin plates of the theca made for an incompetent structure that was rarely preserved. A large percentage of the specimens are more or less crushed and are often imperfect. Specimens are rarely found on weathered surfaces, the thin plates being readily destroyed.

Species referred to the genus.—

Cribanocrinus benedicti (Miller), n. comb.

Rhodocrinus benedicti Miller, 1892, p. 15, pl. 2, figs. 18–20: "Keokuk Group, Harrison County, Indiana" (Borden); 1894, p. 269, pl. 2, figs. 18–20.—Wachsmuth and Springer, 1897, p. 224.

Cribanocrinus bridgerensis (Miller and Gurley), n. comb.

Rhodocrinus bridgerensis Miller and Gurley, 1897, p. 41, pl. 3, fig. 3: "Burlington or Keokuk Group, Bridger Mountains, Montana" (Madison limestone).

Cribanocrinus coxanus (Worthen), n. comb.

Rhodocrinus coxanus Worthen, 1882, p. 29: "Upper part of the geode bed, one mile below Keokuk" (Keokuk) (The geode bed is placed in the Warsaw by some authors); 1883, p. 305, pl. 28, fig. 7.—Wachsmuth and Springer, 1885, p. 99 (321); 1897, p. 222, pl. 13, figs. 6, 7.

Cribanocrinus parvus (Miller), n. comb.

Rhodocrinus parvus Miller, 1891, p. 39, pl. 5, figs. 8, 9: "Keokuk group, Booneville, Cooper County, Missouri" (at present considered Warsaw).—Wachsmuth and Springer, 1897, p. 229.

Cribanocrinus punctatus (Weller), n. comb.

Rhodocrinus punctatus Weller, 1909, p. 282, pl. 11, figs. 15, 16: Fern Glen formation, Jefferson County, Missouri.

Cribanocrinus urceolatus (Wachsmuth and Springer), n. comb.

Rhodocrinus wortheni Hall, var. *urceolatus* Wachsmuth and Springer, 1897, p. 221, pl. 12, figs. 8a, b: "Age of the Lower Burlington limestone, Lake Valley, New Mexico" (Lake Valley limestone).

Cribanocrinus wachsmuthi (Hall), n. comb.

Rhodocrinus wachsmuthi Hall, 1861, p. 18: No horizon or locality given (Lower Burlington, Burlington, Iowa).—Wachsmuth and Springer, 1881, p. 213 (387); 1897, p. 222, pl. 13, figs. 5b–d (not fig. 5a = *C. wortheni*), pl. 15, fig. 7.

Cribanocrinus watersianus (Wachsmuth and Springer), n. comb.

Rhodocrinus watersianus Wachsmuth and Springer, 1889, p. 184, pl. 17, fig. 16: Kinderhook, Le Grand, Iowa (Hampton formation).—Miller, 1889, p. 278, text fig. 421.—Wachsmuth and Springer, 1890, p. 184, pl. 17, fig. 16; 1897, p. 221, pl. 12, fig. 9.—Laudon and Beane, 1937, p. 241, pl. 15, fig. 1.

Cribanocrinus whitei (Hall), n. comb.

Rhodocrinus whitei Hall, 1861a, p. 9: "In sandstone of Chemung group at base of Burlington limestone, Burlington, Iowa" (Lower Burlington); 1861b, p. 325; 1872, pl. 6, figs. 19–21.—Wachsmuth and Springer, 1881, p. 213 (387); 1897, p. 223, pl. 13, figs. 1a–c; pl. 15, figs. 6a, b.

Cribanocrinus wortheni (Hall), n. comb.

Rhodocrinus wortheni Hall, 1858, p. 556, pl. 9, figs. 8a–c: Burlington limestone, Burlington, Iowa (Lower Burlington).—Wachsmuth and Springer, 1881, p. 213 (387); 1897, pl. 11, fig. 6; pl. 12, figs. 7a–c; pl. 13, fig. 5a (as *Rhodocrinus wachsmuthi*).

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BOTANY.—*The Alaskan species of* Puccinellia.[1] Jason R. Swallen, Bureau of Plant Industry, Soils, and Agricultural Engineering.

Several years ago, Dr. Eric Hultén, Botaniska Museet, Lund University, Sweden, sent a large number of specimens of *Puccinellia* from Alaska for study and identification. Most of them were collected by Dr. Hultén on rather extensive trips in Alaska and Yukon. The report on this collection was to have formed the basis for the treatment of *Puccinellia* in Dr. Hultén's *Flora of Alaska*, but it was not received until after the second part containing the grasses had gone to press. Since the author's treatment differs considerably from that in Dr. Hultén's flora this account was prepared for publication.

This study is based on the specimens sent by Dr. Hultén, those in the U.S. National Herbarium, and those in the herbarium of the U.S. National Arboretum. Dr. J. P. Anderson, who has made extensive botanical collections in Alaska over a period of years, also sent all his specimens of *Puccinellia* to the author for examination. The assistance given the author by Dr. Hultén and Dr. Anderson is gratefully acknowledged.

[1] Received October 12, 1943.

Puccinellia is one of the circumpolar genera of grasses well represented in North America, especially in Alaska. The species furnish a considerable amount of forage, being leafy, densely tufted grasses. The genus is taxonomically a difficult one, the species being variable and closely allied. Many species have been proposed, but the genus as a whole has not been intensively studied, and the nomenclature is much involved. Some species are common to America and Eurasia, and in the preparation of this paper those of the circumpolar regions have been studied so far as possible.

Puccinellia Parl. Fl. Ital. **1**: 366. 1848.

Atropis Rupr. in Griseb. in Ledeb. Fl. Ross. **4**: 388. 1853.

Spikelets several-flowered, usually terete or slightly flattened; glumes rather firm, often scarious at the tip, 1- to 3-nerved; lemmas usually firm, rounded on the back, usually scarious and often erose at the tip, 5-nerved, the nerves parallel, usually indistinct. Low smooth cespitose annuals or perennials with narrow to open panicles.

Puccinellia differs from *Poa* chiefly in the rounded lemmas with usually indistinct parallel nerves. The species are mostly found on seashores, in brackish marshes or meadows near the coast, or in alkaline soils in the interior. They range from the Arctic regions of both hemispheres to the middle Western States in America, with a few species in southern South America; to the British Isles and the north coast of the Mediterranean, and to central China and Japan in the Old World. One species is found in Africa and a few in Australia and New Zealand.

KEY TO ALASKAN SPECIES

Anthers 1.8 to 2 mm long; plants low, frequently with widely spreading stolons. 1. *P. phryganodes*
Anthers not more than 1.5 mm long; plants not stoloniferous.
  Panicle branches distinctly scabrous.
    Anthers 0.3 to 0.5 mm long; lemmas mostly 1.6 to 1.8 mm long; panicle branches very slender, distinctly reflexed at maturity........................... 2. *P. hauptiana*
    Anthers 0.7 mm long or more; lemmas 2 to 4 mm long; panicle branches, if reflexed, relatively stout.
      Lemmas 3 to 4 mm long; anthers 1.3 to 1.5 mm long; panicle branches usually narrowly ascending, stout, 10 to 20 cm long.................... 3. *P. grandis*
      Lemmas 2 to 2.5 mm, rarely 3 mm, long; anthers not more than 1 mm long; panicle branches ascending to reflexed, slender, rarely more than 5 cm long, not stiff.................... 4. *P. borealis*
  Panicle branches glabrous or (in *P. nutkaensis*) only very sparsely scabrous.
    Lemmas 3.5 to 4 mm long; anthers mostly 1.3 to 1.5 mm long.
      Panicle branches ascending, elongate. Culms 25 to 40 cm tall; spikelets 5- to 7-flowered, 8 to 10 mm long, the florets spreading.................... 5. *P. glabra*
      Panicle branches stiffly spreading or reflexed.
        Spikelets 2- to 3-flowered, 5 to 7 mm long; lemmas 3.5 to 4 mm long, obtuse; culms densely tufted, erect, 45 to 60 cm tall........... 6. *P. triflora*
        Spikelets 5- to 7-flowered, 6 to 8 mm long; lemmas not more than 3.5 mm long, acute or subobtuse, sometimes irregularly toothed; culms 15 to 30 cm tall, erect from a rather long decumbent base...... 7. *P. andersoni*
    Lemmas not more than 3 mm long, or if so, the panicle branches appressed; anthers mostly less than 1 mm long.
      Lemmas thin (see also *P. kamtschatica*), strongly nerved; anthers 0.3 to 0.6 mm long.
        Lemmas 3 to 3.3 mm long; anthers of lowest floret 0.3 to 0.4 mm long; culms as much as 30 cm tall. 8. *P. alaskana*
        Lemmas 2 to 2.5 mm long; anthers of lowest floret 0.5 to 0.6 mm long; culms usually less than 10 cm tall........................ 9. *P. paupercula*
      Lemmas firm (thin in *P. kamtschatica* but the nerves not prominent), the nerves obscure (except the lateral nerves at the base in *P. pumila*); anthers mostly 0.8 to 1 mm long.
        Palea longer than the lemma; plants soft with slender culms 15 to 25 cm tall; panicle branches ascending or, at maturity, spreading or reflexed. Lemmas thin, shining, obtuse............................ 13. *P. kamtschatica*
        Palea equaling the lemma or shorter; plants relatively hard, the culms densely tufted or coarse; panicle branches appressed or stiffly spreading, usually stout.
          Panicle branches stout, stiffly spreading or reflexed, naked in lower half.
            Culms stout, erect from a decumbent base; blades erect, flat, 2 to 2.5 mm wide; lower panicle branches in whorls, long and short ones intermixed, glabrous or obscurely scabrous............................. 10. *P. hulteni*

Culms relatively slender, densely tufted, erect or ascending, but the base not decumbent; blades spreading, usually convolute; panicle branches solitary or in pairs with no short ones intermixed, glabrous, with a characteristic pearly lustre. Pedicels swollen below the spikelets..... ....11. *P. pumila*

Panicle branches slender, usually closely appressed, sparsely hispid-scabrous.......12. *P. nutkaensis*

1. **Puccinellia phryganodes** (Trin.) Scribn. & Merr. Contr. U. S. Nat. Herb. **13**: 78. 1910

Poa phryganodes Trin. Mém. Acad. St. Pétersb. VI. Math. Phys. Nat. **1**: 389. 1830.

Perennial; culms 5 to 15 cm tall, erect or ascending from slender rhizomes, frequently with widely spreading stolons; culm sheaths overlapping, those on the stolons usually much shorter than the internodes; ligule 0.5 to 1 mm long, truncate, decurrent; blades soft, lax, mostly involute, 2 to 8 cm, usually less than 5 cm, long; panicles 2 to 2.5 cm long, few-flowered, the short glabrous branches appressed, naked below; spikelets 3- to 5-flowered, 5 to 7 mm long; glumes firm, obtuse, the first elliptic, 1.8 to 2 mm long, 1 nerved, the second elliptic to obovate, 2.5 to 3 mm long; lemmas firm, obtuse, elliptic, glabrous, the lowest 3.5 to 3.8 mm long; palea as long as the lemma, subacute, the keels glabrous; anthers 1.8 to 2 mm long.

Type locality: Kotzebue Sound, Alaska.

Seashores, mud flats, and brackish marshes, Pribilof Islands, Alaska, and Greenland.

SEWARD PENINSULA: Port Clarence, *Walpole* 1633, 1718. NORTON SOUND: St. Michael, *Hitchcock* 4714. PRIBILOF ISLANDS: St. Paul, *Johnston*, June 8 and July 4, 1923 (H), *Hultén* 7330; *J. M. Macoun Geol. Surv. Can.* 16233. ALASKA PENINSULA: Port Moller, *Murie* 2150. SOUTHEASTERN ALASKA: Glacier Bay, *Cooper* 130.

2. **Puccinellia hauptiana** (Krecz.) Kitagawa, Rep. Inst. Sci. Res. Manchukuo **1**: 255. 1937

Atropis hauptiana Krecz. in Kom. Fl. U.R.S.S. **2**: 485, 763, *pl. 36, f. 21.* 1934. *Poa hauptiana* Trin. ex Kom. Fl. U.R.S.S. **2**: 485, 763. 1934, as synonym.

Perennial; culms slender, erect to prostrate, sometimes forming mats, 10 to 40 cm long; sheaths mostly longer than the internodes; ligule 1.5 to 2.5 mm long, obtuse, decurrent; blades 3 to 8 cm long, not more than 1.5 mm wide, flat or loosely involute, especially those on the innovations, the margins more or less scabrous; panicles 3.5 to 15 cm long, the slender scabrous, somewhat flexuous, spreading to reflexed branches mostly in rather distant pairs, naked in the lower third or half, the lowest as much as 7 cm long; spikelets 3- to 5-flowered, 3 to 4 mm long, appressed; glumes acute or subobtuse, the first 1 to 1.5 mm long, 1-nerved, the second 1.2 to 2 mm long, 3-nerved; lemma of lowest floret 1.6 to 2 mm long, obtuse, tinged with bronze or purple, glabrous or very sparsely pubescent on the callus; anthers 0.3 to 0.5 mm long.

Type locality: Siberia.

Wet ground and river banks, Siberia; Alaska, Yukon, and Alberta.

ALASKA: Rampart, *Hitchcock* 4460; Circle City, *Hitchcock* 4437, *J. P. Anderson* 2543; Tanana, *Hitchcock* 4641; Fairbanks, *Hitchcock* 4576, 4617; Copper Center, *Heideman* 2, *Went* 207(H); Gulkana, *J. P. Anderson* 2734; Chitina, *J. P. Anderson* 2028. YUKON: Dawson, *Hitchcock* 4323, 4352. ALBERTA: Banff, *McCalla* 2324.

3. **Puccinellia grandis** Swallen, sp. nov.

Perennis; culmi 50–90 cm alti, dense caespitosi, erecti vel geniculati; vaginae glabrae, inferiores internodiis longiores, superiores internodiis breviores; ligula 2–3 mm longa, obtusa, membranacea; laminae firmae, elongatae, 2–3.5 mm latae, eae innovationum molles, angustiores; paniculae 10–20 cm longae, ramis appressis vel denique patentibus, ad apicem scabris, basi nudis; spiculae 8–15 mm longae, 5–12-florae, appressae; gluma prima 2–3 mm longa, obtusa vel subacuta; gluma secunda 3–3.5 mm longa, obtusa, minute dentata; lemmata 3–4 mm longa, obtusa vel subacuta, obscure nervosa, basi sparse pilosa; palea lemma aequans, carinis obscure ciliatis; antherae 1.3–1.5 mm longae.

Perennial; culms 50 to 90 cm tall, densely tufted, erect or geniculate at the lower nodes; sheaths glabrous, the lower longer, the upper shorter than the internodes; ligule membrana-

ceous, obtuse, 2 to 3 mm long; blades firm, flat or drying involute, elongate, mostly 2 to 3.5 mm wide, those of the innovations often soft and fine; panicles 10 to 20 cm long, pyramidal, the scabrous branches at first appressed but often finally stiffly spreading, usually naked at the base; spikelets 8 to 15 mm long, 5- to 12-flowered, appressed, rather prominently tinged with purple; first glume 2 to 3 mm long, 1-nerved, obtuse or sometimes subacute; second glume 3 to 3.5 mm long, 3-nerved, broader than the first, obtuse, often minutely toothed; lemmas 3 to 4 mm long, rather abruptly narrowed to an obtuse or subacute apex, sparsely pilose at the base, the nerves rather obscure; palea as long as the lemma, obscurely ciliate on the keels; anthers mostly 1.3 to 1.5 mm, rarely as much as 2 mm long.

Type in the U. S. National Herbarium, no. 948937, collected on high sea beaches at Seattle, Wash., June 1890, by C. V. Piper (no. 1451).

Salt marshes and sandy or rocky seashores, Alaska to central California.

Specimens of this species have previously been referred to *Puccinellia nutkaensis*, which is much smaller, the culms mostly 15 to 30 cm tall, with closely appressed, obscurely scabrous branches, the lemmas not more than 3 mm long the anthers mostly only 0.8 to 1 mm long.

ALASKA: Skagway, *Hitchcock* 4186, 4197, 4203; Juneau, *Hitchcock* 4068, 4077; Aurora, *Piper* 4699; Glacier Bay, *Cooper* 106. YUKON: Whitehorse, *Hitchcock* 4289. BRITISH COLUMBIA: Cadbow Bay, *Macoun* 66; Crescent, *Henry* 7; Vancouver Island, *Hitchcock* 4887, *Macoun* 245, *Geol. Surv. Can.* 81003, 91951. WASHINGTON: Seattle, *Piper* 1451; Olympic, *Hitchcock* 23448. OREGON: Gearhart to Tillamook Head, *Chase* 4923; near Gearhart, *Shear & Scribner* 1718. CALIFORNIA: Eureka, *Hitchcock* 13085, *Tracy* 3742, 4820; Samoa, *Tracy* 3147; Point Reyes Peninsula, *Burtt-Davy* 6749.

4. **Puccinellia borealis** Swallen, sp. nov.

Perennis; culmi densi caespitosi, 25–35 cm alti, erecti, basi decumbentes; vaginae internodiis paulo longiores, glabrae, inferiores molles rufo-fuscae; ligula 2 mm longa, obtusa vel truncata, hyalina; laminae 4–8 cm longae, 1–2 mm latae, planae, infra glabrae, supra scabrae, marginibus scabris; paniculae 10–14 cm longae, ramis gracilibus scabris adscendentibus vel reflexis, inferioribus 4–5 cm longis in dimidio inferiore nudis; spiculae 4–6-florae, 4–5 mm longae, appressae, breviter pedicellatae; gluma prima 1–1.5 mm longa, acuta; gluma secunda 1.5–2 mm longa, obovata, obtusa; lemmata 2–2.3 mm longa, obtusa vel subtruncata, minute eroso-ciliata; palea lemmate paulo brevior et multo angustior, carinis hispido-ciliatis; antherae 0.6–0.7 mm longae.

Perennial; culms densely tufted, 25 to 35 cm tall, erect from a usually decumbent base; sheaths mostly a little longer than the internodes, glabrous, the lowermost soft, reddish brown, loose, papery, becoming more or less fibrous; ligule about 2 mm long, obtuse or truncate, hyaline; blades 4 to 8 cm long, 1 to 2 mm wide, flat, glabrous below, scabrous above and on the margins; panicles 10–14 cm long, the slender scabrous branches ascending to reflexed, in rather distant fascicles of 2 to 4, the lower mostly 4–5 cm long, naked for nearly half their length; spikelets 4- to 6-flowered, 4 to 5 mm long, tinged with purple, short-pediceled, appressed to the branches; first glume 1 to 1.5 mm long, acute; second glume 1.5 to 2 mm long, obovate, obtuse;lemmas 2 to 2.3 mm long, obtuse or subtruncate, minutely erose-ciliate; palea a little shorter than the lemma, bifid at the apex, about 0.5 mm wide between the hispid-ciliate keels, much narrower than the broad lemma; anthers 0.6 to 0.7 mm long.

Type in the U. S. National Herbarium, no. 379136, collected on tundra bank, Teller Reindeer Station, near Port Clarence, Alaska, September 7, 1901, by F. A. Walpole (no. 2015).

Seacoast and moist ground, mostly along rivers, Alaska and Yukon.

SEWARD PENINSULA: Deering, *J. P. Anderson* 4788; Kotzebue, *J. P. Anderson* 4670; Port Clarence, *Walpole* 2015; Nome, *Hitchcock* 4815, *J. P. Anderson* 4991. NORTON SOUND: St. Michael, *Hitchcock* 4700. YUKON VALLEY: Fort Yukon, *Bates* in 1889; Tanana, *Henderson* 14988. TANANA VALLEY: Fairbanks, *Hitchcock* 4594, *J. P. Anderson* 1444. YUKON: Dawson, *Hitchcock* 4358.

These specimens have been referred to *P. distans* (L.) Parl., but they are very different in appearance from typical European material. The Alaskan plants are perennial, while the typical European species appears to be annual;

the panicle branches are more slender and not so densely flowered, and the lemmas not so conspicuously broad at the summit. J. P. Anderson, who has studied the plants of Alaska for many years, states that the Alaskan species that has been referred to *P. distans* is apparently native, not introduced into America as is *P. distans*.

Puccinellia borealis is closely related to *P. sibirica* Holmb., differing chiefly in the smaller florets. None of the Siberian material examined agrees with the Alaskan specimens cited above; hence, without a specimen of Holmberg's species for comparison, it seems better to propose a new species than to refer these doubtfully to *P. sibirica*.

5. **Puccinellia glabra** Swallen, sp. nov.

Perennis; culmi 25–40 cm alti, erecti vel basi decumbentes, glabri; vaginae glabrae internodiis longiores; ligula obtusa, decurrens, 3–5 mm longa; laminae 5–14 cm longae, 1.5–3 mm latae, planae vel ad apicem involutae, glabrae; paniculae 10–20 cm longae, ramis adscendentibus, glabris, 4–10 cm longis, basi nudis; spiculae 5–7-florae, 8–10 mm longae, appressae; gluma prima 2–3 mm longa, 1-nervia, acuta vel subobtusa; gluma secunda 3–4 mm longa, 3-nervia, obtusa, minute ciliolata; lemmata 3.5–4 mm longa, obtusa, glabra vel basi sparse pilosa, lucida, obscure nervata; paleae in carinis glabrae; antherae 1.3–1.5 mm longae.

Rather densely tufted perennial; culms 25 to 40 cm tall, erect or decumbent at the base, glabrous; sheaths glabrous, longer than the internodes; ligule thin, obtuse, decurrent, 3 to 5 mm long; blades 5 to 14 cm long, 1.5 to 3 mm wide, flat or becoming involute toward the tip, glabrous; panicles mostly 10 to 20 cm long, the glabrous branches ascending, 4 to 10 cm long, naked at the base; spikelets 5- to 7-flowered, 8 to 10 mm long, appressed, the florets somewhat spreading, pale or tinged with purple; first glume 2 to 3 mm long, 1-nerved, acute or subobtuse; second glume 3 to 4 mm long, 3-nerved, obtuse, minutely ciliolate; lemmas 3.5 to 4 mm long, obtuse, glabrous, or with a few hairs at base, rather thin and shining, the nerves obscure; palea a little shorter than the lemma, the keels not ciliate; anthers 1.3 to 1.5 mm long.

Type in the U. S. National Herbarium, no. 749542, collected on flats frequently overflowed by tides, Kasilof ("Kussiloff"), Kenai Peninsula, Alaska, in 1898 by Walter H. Evans (no. 609).

The relationship of *Puccinellia glabra* to the other Alaskan species is obscure. The relatively long ascending panicle branches, the spreading florets, and long lemmas are characteristic.

Tidal flats, Alaska and Kenai Peninsulas and Kodiak Island.

ALASKA PENINSULA: Women's Peninsula, *Church* in 1916. KENAI PENINSULA, Kasilof, *Evans* 609. KODIAK ISLAND, *Piper* 4696.

6. **Puccinellia triflora** Swallen, sp. nov.

Perennis; culmi erecti, dense caespitosi, 45–60 cm alti; vaginae glabrae internodiis paulo longiores; ligula 4–5 mm longa, tenuis, obtusa, decurrens; laminae 4–6 cm longae vel eae innovationum longiores, 1–1.5 mm latae, molles, glabrae, planae vel involutae; paniculae 15–20 cm longae, ramis fasciculatis abrupte patentibus vel reflexis basi nudis; spiculae 5–7 mm longae, 2–3-florae, appressae, purpurascentes; glumae acutae vel subobtusae, prima 1.5–3 mm longa, 1-nervia, secunda 2.5–4 mm longa, 3-nervia; lemmata 3.5–4 mm longa, lata, obtusa, basi sparse pilosa; palea lemma aequans, carinis prominentibus glabris; antherae 1.3–1.5 mm longae.

Erect, densely tufted perennial; culms 45 to 60 cm tall, glabrous; sheaths glabrous, overlapping or a little shorter than the internodes; ligule thin, obtuse, decurrent, 4 to 5 mm long; blades 4 to 6 cm long or those of the innovations longer, 1 to 1.5 mm wide, soft, glabrous, flat or becoming loosely involute; panicles 15 to 20 cm long, the branches glabrous, in rather distant fascicles of 2 to 4, naked at base, stiffly and abruptly spreading or reflexed, the branchlets appressed; spikelets 5 to 7 mm long, 2 or 3-flowered, appressed, deeply tinged with purple; glumes acute or sometimes subobtuse, the first 1.5 to 3 mm long, 1-nerved, the second 2.5 to 4 mm long, 3-nerved; lemmas 3.5 to 4 mm long, broad, obtuse, the nerves evident, sparsely pilose at the base or nearly glabrous; palea as long as the lemma, the keels prominent, glabrous; anthers 1.3 to 1.5 mm long.

Type in the U. S. National Herbarium, no. 948675, collected on flat near creek, at Tyoonok ("Tyoonock"), Cook Inlet, Alaska, by Walter H. Evans in 1897 (no. 480).

Puccinellia triflora is related to *P. glabra*, differing in the taller culms and stiffly spread-

ing or reflexed panicle branches, and in the spikelets only 2- or 3-flowered.

This species was also collected on flats that are overflowed by spring tides at Kasilof ("Kussiloff"), Kenai Peninsula, *Evans* 684.

7. **Puccinellia andersoni** Swallen, sp. nov.

Perennis; culmi densi caespitosi, erecti, basi decumbentes, 15–30 cm alti; vaginae glabrae, internodiis longiores, inferiores tenues, rufo-fuscae; ligula 2 mm longa, decurrens; laminae planae, 5–11 cm longae, 1–2.5 mm latae, glabrae; paniculae 4–8 cm longae, ramis rigidis, glabris, adscendentibus vel patentibus, 2–4 cm longis, 1–5-spiculatis; spiculae 5–7-florae, 6–8 mm longae; gluma prima 2 mm longa, acuta; gluma secunda 2.5–3 mm longa, latior, acuta vel subobtusa; lemmata 3–3.5 mm longa, acuta, dentata, basi sparse pilosa; palea lemma aequans, carinis prope apicem sparse scabris; antherae 0.8–1 mm longae.

Perennial; culms densely tufted, erect from a decumbent base, 15 to 30 cm tall, with short ones, 5 to 8 cm tall, apparently from the outside of the clump; sheaths glabrous, longer than the internodes, the lower loose, thin, reddish brown, becoming fibrous; ligule thin, decurrent, 2 mm long; blades flat, 5 to 11 cm long, 1 to 2.5 mm wide, glabrous; panicles 4 to 8 cm long, the branches relatively stout, glabrous, stiffly ascending to spreading, 2 to 4 cm long, bearing 1 to 3 or sometimes 5 appressed spikelets; spikelets 5- to 7-flowered, 6 to 8 mm long; first glume 2 mm long, acute, the second 2.5 to 3 mm long, much broader, acute or subobtuse; lemma 3 to 3.5 mm long, usually acute, sometimes irregularly toothed, sparsely pilose at the base and on the lower part of the prominent nerves; palea as long as the lemma, the keels sparsely scabrous near the summit; anthers 0.8 to 1 mm long.

Type in the herbarium of the U. S. National Arboretum, collected in very wet soil, Point Lay, Arctic Alaska, August 5, 1938, by J. P. Anderson (no. 4399a).

This is a rather distinct species and its relationship is not evident. The long decumbent base, short, stiffly spreading panicle branches, and acute, more or less toothed, lemmas are characteristic. Only known from the type collection. Mr. Anderson's no. 4399 consisted of specimens of this species and of *Puccinellia paupercula*. Those of *P. andersoni* have been labeled 4399a, while those of *P. paupercula* have been labeled 4399b.

8. **Puccinellia alaskana** Scribn. & Merr. Contr. U. S. Nat. Herb. **13**: 78. 1910

Puccinellia paupercula var. *alaskana* Fern. & Weath. Rhodora **18**: 18. 1916.

Perennial; culms in small dense tufts, erect or ascending, 6 to 30 cm tall; sheaths soft, much longer than the internodes; ligule 2 to 3.5 mm long, hyaline, decurrent; blades flat or loosely folded, 2 to 9 cm long, 1 to 2 mm wide; panicles 3 to 9 cm long, the short slender glabrous branches appressed or ascending; spikelets 3- or 4-flowered, 4 to 5 mm long; glumes contorted, strongly nerved, the first 1 to 1.5 mm long, subacute to obtuse, entire, the second 2 to 2.5 mm long, 3-nerved, oblong to obovate, entire or erose; lemma prominently 5-nerved, abruptly narrowed to an irregular subacute tip, densely pubescent at the base, the lowest 3 to 3.3 mm long; palea as long as the lemma, ciliate on the keels; anthers of lowest floret 0.4 to 0.5 mm long.

Differs from *P. paupercula* in its usually larger size, flat broader blades, and its longer more distant lemmas, densely pubescent below (nearly glabrous in *P. paupercula*).

Type locality: St. Paul, Pribilof Islands.

Islands of Bering Sea and Western Alaska.

SEWARD PENINSULA: Port Clarence, *Walpole* 1889. NUNIVAK ISLAND: Nash Harbor, *J. P. Anderson* 3864. ST. MATTHEW ISLAND: *Cole* in 1899. PRIBILOF ISLANDS: St. Paul, *Haley* in 1925, *Hultén* 7489, 7498(H), *Johnston*, June 30, 1923(H), *Kincaid*, Aug. 24, 1897, *Macoun*, Aug. 11, 1892, and in *Geol. Surv. Can.* 94198, *Merriam*, Aug. 4, 1891, *Trelease & Saunders* 2960; St. George, *W. H. Palmer* "Aug. 11," *Johnston*, Aug. 5, 1920. ALEUTIAN ISLANDS: Agattu, *Hultén* 6319; Semisopochnoi, *Steenis* 4619(H); Atka, *Eyerdam* 994, *Hultén* 6996, 7017; Amlia, *Eyerdam* 1272, 1273; Carlisle, *Eyerdam* 1387; Umnak, *Hultén* 7086(H); "Ogliuga," *Murie* 2108. SHUMAGIN ISLANDS: Popof, *Kincaid*, July 14, 1899.

9. **Puccinellia paupercula** (Holm) Fern. & Weath. Rhodora **18**: 18. 1916

Glyceria paupercula Holm, Repert. Sp. Nov. Fedde **3**: 337. 1907.

Perennial; culms very slender in small dense tufts, 5 to 15 cm tall, scarcely exceeding the blades; sheaths crowded, the lowest rather papery becoming shredded in age; ligule 0.5 to 0.8 mm long, usually not decurrent; blades 2 to 4 cm long, 0.5 to 1 mm wide, flat or usually loosely involute, straight or falcate; panicles 1 to 7 cm long, few-flowered, the slender glabrous relatively distant branches appressed or sometimes spreading, naked below; spikelets 3- to 5-flowered, 4 to 8 mm long, the florets not crowded; first glume 1 to 1.5 mm long, 1-nerved, acute to subobtuse; second glume 1.5 to 2 mm long, 3-nerved, subacute to obtuse; lower lemma rather strongly 5-nerved, 2 to 2.5 mm long (rarely to 2.8 mm), elliptic to obovate, erose, glabrous or very sparsely pilose at the base; palea a little shorter than the lemma, the keels glabrous; anthers 0.5 to 0.6 mm long.

Type locality: Mansfield Island, Hudson Bay.

Rocky and sandy shores, Arctic America.

Arctic Alaska: Point Lay, *J. P. Anderson* 4399b; Point Hope, *J. P. Anderson* 4603; Point Martin, *Johansen* 145 (Geol. Surv. Can. 97948). Bering Strait: St. Lawrence Island, *Geist*, July–Aug. 1931; "Arakamtchetchene" Island, *Wright* in 1853–56. Aleutian Islands: Agattu, *Hultén* 6320; Unalga, *Steenis* 4658(H).

10. **Puccinellia hulteni** Swallen, sp. nov.

Perennis; culmi rigidi, erecti, basi decumbentes, 35–40 cm alti; vaginae internodiis longiores, glabrae; ligula 2.5–3 mm longa, tenuis, decurrens; laminae 5–11 cm longae, 2–2.5 mm latae, erectae, nervosae, glabrae; paniculae 8–14 cm longae, ramis rigide adscendentibus vel patentibus, glabris vel obscure scabris, inferioribus 5–8 cm longis, in parte superiore floriferis; spiculae 3–4-florae, 5–6 mm longae; gluma prima 1.5–2 mm longa, 1-nervia, acuta vel subacuta; gluma secunda 2–2.5 mm longa, 3-nervia, obtusa vel subacuta; lemmata 2.5–2.8 mm longa, subobtusa, basi obscure pubescentia; palea lemmate brevior, minute dentata, carinis scabris; antherae 0.8 mm longae.

Perennial; culms stiffly erect from a decumbent base 35 to 40 cm tall; sheaths much longer than the internodes, glabrous; ligule hyaline, decurrent, 2.5 to 3 mm long; blades 5 to 11 cm long, 2 to 2.5 mm wide, narrower on the innovations, stiff, erect, strongly nerved, glabrous; panicles 8 to 14 cm long, the glabrous or obscurely scabrous branches stiffly ascending or spreading, the lower 5 to 8 cm long with shorter ones intermixed, loosely few-flowered above the middle; spikelets 3- or 4-flowered, 5 to 6 mm long; first glume 1.5 to 2 mm long, 1-nerved, acute or subacute, the second 2 to 2.5 mm long, broader than the first, 3-nerved, subacute or obtuse; lemma 2.5 to 2.8 mm long, acutish, obscurely pubescent on the strong lateral nerves at the base; palea a little shorter than the lemma, minutely toothed, rather strongly scabrous on the keels, especially toward the summit; anthers 0.8 mm long.

Type in the U. S. National Herbarium, no. 1819613, collected at Port Hobron, Sitkalidak Island, Kodiak, Alaska, August 20, 1931, by W. J. Eyerdam (no. 131).

The stiffly erect culms with erect flat blades and open panicles with stiffly ascending branches of irregular length are characteristic. Probably most closely related to *P. pumila* which is much smaller, with short densely flowered branches and much more obtuse lemmas.

Seashores, Kodiak and neighboring islands, Kenai Peninsula, and southeastern Alaska.

Kodiak: Old Harbor, *Eyerdam* 651; Sitkalidak Island, *Eyerdam* 131. Kenai Peninsula: Tutka Bay, *Hultén* 7782. Southeastern Alaska: Sitka, *Hultén* 8582.

11. **Puccinellia pumila** (Vasey) Hitchc. Amer. Journ. Bot. **21**: 129. 1934

Glyceria pumila Vasey, Torrey Bot. Club Bull. **15**: 48. 1888.

Atropis kurilensis Takeda, Journ. Linn. Soc. Bot. **42**: 497. 1914.

Puccinellia kurilensis Honda, Journ. Fac. Sci. Univ. Tokyo Sec. III, Bot. **3**: 59. 1930.

Perennial; culms in loose or rather dense tufts, erect or decumbent at the base and geniculate-ascending, 10 to 30 cm tall; sheaths usually much longer than the internodes; ligule 1.5 to 2.3 mm long, hyaline, truncate, decurrent; blades flat, as much as 20 cm long, usually much shorter, 1 to 2.5 mm wide, scaberulous; panicles 2.5 to 15 cm long, the glabrous branches stiffly ascending to reflexed, naked in the lower half, sometimes in depauperate specimens bearing only a single spikelet; spikelets 4- to 6-flowered, 5 to 7 mm long, appressed;

first glume 1.5 to 2.5 mm long, 1-nerved, subacute; second glume 2.5 to 3 mm long, 3-nerved, subacute; lower lemma about 3 mm long, rather abruptly narrowed toward the subacute apex, the nerves usually conspicuous, sparsely pubescent on the callus; palea as long as the lemma, the keels glabrous; anthers of lower floret 0.8 to 1.2 mm long.

The eastern material which has been referred to this species requires further study, at least some of it may represent another species.

Type locality: Vancouver Island.

Brackish marshes and seashores, Alaska to Vancouver Island.

Kodiak: *Griggs*, Aug. 15, 1915, *Piper* 4701. Cook Inlet: Halibut Cove, *Coville & Kearney* 2456. Prince William Sound: Orca, *Coville & Kearney* 1336. Southeastern Alaska: Sitka, *Hitchcock* 4139½; Skwashianski Bay, *Piper* 4698.

12. **Puccinellia nutkaensis** (Presl) Fern. & Weath. Rhodora **18**: 22. *f. 49–53*. 1916

Poa nutkaensis Presl, Rel. Haenk. **1**: 272. 1830.

Perennial; culms relatively slender in dense tufts, mostly 15 to 30 cm tall, rarely as much as 45 cm, erect or sometimes ascending at the base; sheaths overlapping or the upper occasionally shorter than the internodes; ligule 1 to 2 mm long, obtuse or truncate, decurrent; blades 3 to 13 cm long, 1 to 2 mm wide, soft, flat or folded, glabrous or very sparsely scabrous on the upper surface; panicles 5 to 12 cm long, the few slender glabrous branches appressed, naked toward the base, the lower rarely more than 5 cm long; spikelets 4- to 6-flowered, 7 to 8 mm long; first glume 1.5 to 2 mm long, 1-nerved, subobtuse; second glume 2 to 2.5 mm long, 3-nerved, ovate or broadly elliptic, obscurely ciliolate; lemma of lowest floret 3 mm long, elliptic, glabrous except for a few hairs on the callus and sometimes on the lateral nerves near the base; palea as long as the lemma, sparsely scabrous; anthers 0.8 to 1.2 mm long.

Type locality: "Nootka Sound?"

Beaches and sandy or rocky soil near the coast, Alaska.

This is on the whole a characteristic and uniform species, apparently the commonest of those found in Alaska.

Aleutian Islands: Atka, *Hultén* 6989(H), 7012, *Turner* 1208. Shumagin Islands: Popof, *Hultén* 7742, *Saunders*, July 7–18, 1899, *Trelease & Saunders* 2946. Kodiak Island: *Eyerdam* 497, *Coville & Kearney* 2240, *Trelease & Saunders* 2942, 2945, 2973, *Cole*, July 19, 1899, *Kincaid*, July 20, 1899. Alaska Peninsula: Kukak Bay, *Coville & Kearney* 1588; Fox Bay, *Griggs*, July 28, 1913. Kenai Peninsula, Tutka Bay, *Hultén* 7785 (H). Prince William Sound: Hinchinbrook Island, *Norberg*, June 4, 22(H), and 28, July 14, 1936, July 14 and 20, 1937; Knight Island, *Eyerdam* 10; Cordova, *Hitchcock* 4145. Yakutat Bay: *Funston* 31, *Trelease & Saunders* 2939. Southeastern Alaska: Skagway, *J. P. Anderson* 1717(H), 1719, *Eastwood* 730, 730A, *Walker* 808; Yes Bay, *Howell* 1718, Lynn Canal, *Krause* 276, 276a(H); Juneau, *J. P. Anderson* 197; Howkan, *Evans* 144; Davidson Glacier, *Cooper* 76; Sitka, *Coville & Kearney* 843, *Evans* 257, *Hitchcock* 4053, *Piper* 4697, *W. G. Wright* 1585, 1593; Chichagof Island, *Norberg* 183, 188, 203; Ketchikan, *J. P. Anderson* 481.

13. **Puccinellia kamtschatica** Holmb. var. **sublaevis** Holmb. Bot. Not. **1927**: 209. 1927

Perennial; culms rather densely tufted, erect or somewhat decumbent at the base, 12 to 25 cm high; sheaths smooth, all longer than the internodes; ligule membranaceous, about 2 mm long; blades smooth, rather soft, flat or drying involute, not more than 2 mm wide; panicles 4 to 10 cm long, the branches rather narrowly ascending, or eventually spreading, sparsely scabrous, mostly spikelet-bearing in the upper half; spikelets 3- or 4-flowered, 3 to 4 mm long; first glume acute, about half as long as the first lemma; second glume much broader, obtuse, the tip hyaline; lemmas 2 mm long, obtuse, glabrous; anthers 0.6 to 0.8 mm long.

Type locality: Schtschapina, Kamchatka.

Cold wet soil, Kamschatka and Alaska.

Shumagin Islands: Popof, *Hultén* 7747. Southeastern Alaska: Glacier Bay, *Cooper* 165; Holkham Bay, *Cooper* 369.

BOTANY.—*Five new species of* Dryopteris *from Peru.*[1] WILLIAM R. MAXON, United States National Museum.

The new species of *Dryopteris* herewith described are part of the extensive collections made by Dr. J. Francis Macbride in Peru under the auspices of Field Museum of Natural History in 1922 and 1923, the ferns of which were entrusted to the writer for study. The series is a valuable one; but like most large Andean fern collections obtained recently it includes a great deal of critical material which it is impossible to identify without recourse to type specimens in European herbaria or, in the case of several especially difficult genera such as *Elaphoglossum*, without monographic studies. Anything like a complete report is thus not feasible at present. Owing mainly to Christensen's "Revision" and later monographs the situation with respect to *Dryopteris* is sufficiently clear, however, to justify proposing the present new species, all belonging to the subgenus *Lastrea*.

Dryopteris assurgens Maxon, sp. nov.

§*Lastrea*. Rhizoma epigaeum, oblique adscendens vel rampans, 15 cm et ultra longum, gracile (3–4 mm diam.), brunneum, laeve, leviter sulcatum, radices crassas perpaucas emittens, subnudum, parcissime paleaceum, paleis adpressis, interdum propinquis sed non imbricatis, 3–4 mm longis, e basi cordata anguste ovatis vel oblongo-ovatis, 1–1.5 mm latis, acuminatis, glabris, castaneis, lucidis et reticulatis, marginibus scariosis pallidioribus. Folia ut videtur ca. 6, 60–70 cm longa, stipitibus oblique affixis, decurrentibus, non imbricatis, 20–25 cm longis, 2 mm diam., e basi brunnea stramineis, epaleaceis, lucidis, glabris; laminae anguste lanceolatae, 45–55 cm longae, medio 12–16 cm latae, apice acuminatae, pinnato-pinnatifidae, basi abrupte angustatae, rhachi straminea, glabra; pinnae ca. 25-jugae, pleraeque oppositae et patentes, infimae (2 vel 3 paria) auriculiformes, deflexae, 5–15 mm longae; pinnae mediales maximae 6–8.5 cm longae, medio 12–16 mm latae, basi usque ad 18 mm latae, lineari-lanceolatae, attenuatae, subpinnatisectae, membranaceo-herbaceae, glabrae, costis supra strigosis et segmentis ciliolatis exceptis; segmenta ca. 20-juga, pleraque 5–9 mm longa, 2–2.5 mm lata, anguste oblonga, acutiuscula, patentia, subfalcata, fere plana, oblique ciliolata, basi angustissime conjuncta, ala costae latere utroque ca. 0.5 mm lata; segmenta basalia superiora maxima, usque ad 1 cm longa et 3.5 mm lata, saepe crenata et rhachin incumbentia; venae 6–8-jugae, obliquae, manifestae sed non prominulae, simplices vel (segmentis basalibus superioribus) furcatae; sori 6–8-jugi, exacte mediales, mediocres, non-indusiati; sporangia numerosa, glabra.

Type in the herbarium of Field Museum of Natural History, no. 1136977, collected near Playapampa, Peru, altitude about 2700 meters, shaded situation in sphagnum, June 16–24, 1926, by J. Francis Macbride (no. 4517a). The description is drawn partly also from an excellent detached frond mounted on the type sheet of *Dryopteris furva*, the two species, though utterly unlike, having somehow been combined under a single number now divided as no. 4517 and no. 4517a.

In its very long, slender, epigaeous rhizome and few, very oblique fronds with decurrent non-imbricate stipe-bases *Dryopteris assurgens* is similar to *D. longicaulis* (Baker) C. Chr.[2] and *D. cornuta* Maxon,[3] and to these species only. It possibly belongs to the group of *D. sancta* (L.) Kuntze.

Dryopteris furva Maxon, sp. nov.

§*Lastrea*. Rhizoma (pars) curvato-adscendens, 5 cm longum, ca. 8 mm diam., apice laxe squamosum, paleis 3–4 mm longis, ovato-deltoideis, acutis, integris, concavis, brunneis, minute pubescentibus, subopacis. Folia ut videtur 10–12, fasciculata, ca. 55 cm longa, stipitibus ca. 15 cm longis, 1.5 mm diam., brunneis, lucidis, minute pubescentibus, demum glabratis; laminae anguste lineares, 40 cm longae, maxime 4–4.5 cm latae, apice attenuatae, basin versus longe et gradatim angustatae, pinnato-pinnatifidae, rhachi stipiti simili sed graciliore, parce et minute pubescente; pinnae

[1] Published by permission of the Secretary of the Smithsonian Institution. Received October 20, 1943.

[2] Illustrated in Hook. Icon. Pl. **17**: *pl. 1658.* 1886.

[3] Journ. Washington Acad. Sci. **19**: 245. *fig. 1.* 1929.

infra apicem pinnatifidum ca. 30-jugae, sessiles, pleraeque oppositae, inferiores ca. 8-jugae reductae, quarum 4 vel 5 paria infima 1–2 mm solum longa, inter se ca. 3 cm distantia; pinnae mediales maximae 2–3 cm longae, 8–11 mm latae, oblongae vel anguste deltoideo-oblongae, patentes, falcatae, pinnatifidae, apice subacuto leviter lobatae, aerophoris basi pinnarum ellipticis, planis, humilibus, vix perspicuis; segmenta ca. 10-juga, rigide herbacea vel subcoriacea, oblonga, integra, concavo-revoluta, costae latere utroque ala 1–1.5 mm conjuncta, venis 4–6-jugis, simplicibus, obliquis, utrinque prominentibus; costae costulaeque et venae subtus substrigillosae, supra (cum parenchymate) parce strigillosae; sori numerosi, mediales, mediocres; sporangia glabra; indusia firme et rigide affixa, persistentia, pallida, reniformia, copiose pubescentia et ciliata, pilis brevibus, rigidis, simplicibus.

Type in the herbarium of Field Museum of Natural History, no. 535604, collected near Playapampa, Peru, altitude about 2700 meters, shaded situation in sphagnum, June 16–24, 1926, by J. Francis Macbride (no. 4517).

Although the present species runs to the West Indian *D. scalpturoides* (Fée) C. Chr. in Christensen's key, it obviously needs no comparison with that, nor is it closely related to any species previously described. In general appearance, and especially in their polished brown stipe and rachis, individual fronds resemble a narrow form of *D. pavoniana* (Kl.) C. Chr., but that species is larger and, though similar in pubescence, differs greatly in its very slender, wide-creeping, branched rhizome, its abruptly reduced blades (with only one or two pairs of auriculiform or glanduliform basal pinnae), its depressed venation and non-indusiate sori, and the presence of conspicuous tuberculiform aerophores at the base of the larger pinnae.

Dryopteris macbridei C. Chr. & Maxon, sp. nov.

§*Lastrea.* Rhizoma suberectum, crassum, fortasse 5–8 cm longum, ca. 1.5 cm diam., conspicue paleaceum, paleis numerosis, imbricatis vel apice fastigiatis, e basi anguste retusa ca. 1 mm lata subulato-attenuatis, ca. 1 cm longis, brunneo-castaneis, subflexuosis, glabris, integris vel subintegris. Folia ut videtur 8–10, suberecta, 40–60 cm longa, stipitibus 5–10 cm longis, 1.5–2.5 mm diam., basi laxe et decidue paleaceis, dense hirtellis, pilis sordide ochroleucis, subrectis, 1–1.5 mm longis; laminae lanceolato-ellipticae, 35–55 cm longae, medio 7–12 cm latae, apice acuminatae, basin versus abrupte reductae, pinnato-pinnatifidae, rhachi valida stipiti simili; pinnae majores 25–30-jugae, sessiles, pleraeque alternae et patentes, inferiores reductae ca. 8-jugae, quarum ca. 5 paria infima minute glanduliformia, inter se distantia; pinnae mediales maximae 5–6 cm longae, medio 8–10 mm latae, basi 10–13 mm latae, lineari-lanceolatae, subpinnatisectae, apice attenuato oblique lobatae, spongioso-herbaceae, ubique conspicue hirtellae; segmenta patentia, ca. 25-juga, pleraque 4–6 mm longa, ca. 1.5 mm lata, anguste oblonga, acutiuscula, recta, ciliata, marginibus late et valde revolutis, basi anguste conjuncta, ala costae latere utroque ca. 0.5 mm lata; venae 7–9-jugae, simplices; sori 6–8-jugae, paulum supramediales, magni, conferti, a marginibus late revolutis partim occulti, sporangiis non setosis; indusia mediocria, persistentia, conspicue setosa, pilis rigidis ochroleucis.

Type in U. S. National Herbarium, no. 1193334, collected near Yanano, Peru, altitude about 1800 meters, at edge of thicket, June 29, 1923, by J. Francis Macbride (no. 3828); isotype in herb. Field Museum of Natural History, no. 534890.

In general appearance *D. macbridei* resembles *D. utañagensis* Hieron., of Colombia and Ecuador, of which (besides five specimens from Colombia) there is at hand an excellent photograph of the incomplete type specimen from Ecuador (*Stübel* 809); also it was regarded by Christensen as probably most closely related to that species. Among other characters *D. utañagensis* differs sharply, however, in its falcate segments, which have 10 to 12 pairs of veins, margins narrowly and closely revolute, pubescence substrigose, sori medial and non-indusiate, and under surface mostly exposed. In strong contrast are the very deeply and widely revolute margins in *D. macbridei*, which nearly meet over the costule, crowding together the conspicuously setose-indusiate sori and wholly obscuring the leaf tissue. The subhirsute or hirtellous condition is nearly uniform throughout.

Dryopteris densa Maxon, sp. nov.

§*Lastrea.* Rhizoma ut fragmento parvo vide-

tur erectum, magnum. Folia valida, certe suberecta et caespitosa, saltem 1–1.2 m longa, stipitibus 25–30 cm longis, 6–8 mm diam., alte sulcatis, sordide ochraceo-brunneis, tenuiter albido-pilosulis, et praecipue ad basin paleis usque ad 1 cm longis e basi ovata longissime attenuatis ochraceo-brunneis flaccidis tenuibus instructis, demum denudatis; laminae anguste ovatae, 80–90 cm et ultra longae, 30–40 cm latae, apice acuminatae, pinnato-pinnatifidae, basi abrupte angustatae, rhachi albido-pilosula, paleis caducis angustis pallidis paucis praedita; pinnae ca. 30-jugae, pleraeque leviter adscendentes vel subrecte patentes, inferiores (4 vel 5 paria) reductae, suboppositae, deflexae, infimae fere alternae, ca. 1 cm longae; pinnae mediales maximae 15–23 cm longae, basi et medio 2.5–3.5 cm latae, lineares, apicem serratum versus longe attenuatae, pinnatifidae, spongioso-herbaceae, basi aerophoro ochraceo verruciformi humili instructae, costis subtus paleis caducis linearibus laxis pallidis paucis praeditis, utrinque cum costulis et pagina superiore laxe pilosulis; segmenta ca. 30-juga, subrecte patentia, leviter falcata, pleraque 12–18 mm longa, medio ca. 4 mm lata, deltoideo-oblonga vel e basi dilatata lineari-oblonga, acutiuscula vel false acuta, marginibus anguste sed firme revolutis, basi late conjuncta, ala costae latere utroque 1.5–2 mm lata; venae 9–12-jugae, simplices, sub angulo 45° egredientes, immersae; sori 8–11-jugi, mediales, rotundi, magni, creberrimi, sporangiis numerosissimis segmenti paginam inferiorem omnino obtegentibus; indusia perspicua, suborbicularia, papyracea, fere plana, albida, albido-pilosula, receptaculo elevato firme affixa, persistentia.

Type in the herbarium of Field Museum of Natural History, nos. 535250 and 535251, collected at Huacachi, a station near Muña, Peru, altitude about 1950 meters, May 20–June 1, 1923, by J. Francis Macbride (no. 4175); isotype in the U. S. National Herbarium, no. 1193387.

This is a truly remarkable species. The National Herbarium specimen was sent to Christensen, who annotated it (1927) as follows: "Totally different from all species described. Should be described after more complete specimens, if at hand." No new collections have since been received. Nevertheless the necessary additional data are provided by the Field Museum specimens, which include the lower half of a blade, a nearly complete stipe, and a fragment of the rhizome.

Dryopteris densa is a sturdy plant and probably grows to a height of 1.5 meters or more. The species name refers to the superabundant sporangia of the closely crowded sori, completely covering the segments beneath from costule to tightly revolute margin. Except for the presence of the conspicuous but slightly folded, elevated, persistent, whitish indusia in a double regular row, the sori at maturity have lost their distinctness. They are not at all concealed by the margins. These features, coupled with the weakly pilosulous covering of the upper surface of the segments, are noteworthy and, in combination, distinctive. As to habitat the collector's note reads, "Large clump, in thicket."

Dryopteris dumetorum Maxon, sp. nov.

§*Lastrea.* Rhizoma ut videtur late repens (pars praesens ca. 10 cm longa), gracile, 3–5 mm diam., brunneum, laeve, crasse radicosum, praecipue apice paleaceum, paleis subulato-attenuatis, 4–7 mm longis, basi truncata ca. 1 mm latis, opace brunneis, albido-pubescentibus, integris. Folia 3 vel 4, disticha, 45–85 cm longa, stipitibus 10–20 cm longis, 2–3.5 mm diam., sulcatis, e basi brunnescente arcuata olivaceis vel subferrugineis, hinc inde laxe paleaceis, hirtellis, pilis valde inaequalibus, usque ad 1.5 mm longis; laminae anguste lanceolatae, 25–65 cm longae, medio 11–20 cm latae, apice acuminatae, pinnato-pinnatifidae, basi subgradatim vel abrupte reductae, rhachi 1–2 mm diam., notis omnibus stipiti simili; pinnae 20–25-jugae, pleraeque alternae, patentes, inferiores (2–4 paria) reductae, infimae minutissimae, remotae; pinnae maximae 5–10 cm longae, 12–18 mm latae, lanceolatae vel lineari-lanceolatae, basi raro paulum angustatae, apice acuminatae, pinnatifidae, herbaceae, basi aerophoro brunneo rotundo duro instructae, costis supra subdense subtus parce hirtellis, etiam subtus paleis brunneis lineari-lanceolatis parvis (1.5–2.5 mm longis, 0.2–0.4 mm latis) paucis praeditis; segmenta 18–23-juga, pleraque 5–8 mm longa, basi 3–4 mm lata, oblonga, false acuta, subfalcata, subrecte patentia, marginibus anguste revolutis, basi late conjuncta, ala costae latere utroque 1.5–2 mm lata; venae 7–10-jugae, obliquae, prominulae, simplices, cum costulis utrinque oblique hirtellae; sori

6–9-jugi, mediales, rotundati, mediocres; sporangia glabra; indusia ex pilis pluribus albidis rigidis suberectis longis constata.

Type in the herbarium of Field Museum of Natural History, no. 518164, collected near Mito, Peru, altitude about 2700 meters, in partly sunny places of thickets, July 8–22, 1922, by J. Francis Macbride and William Featherstone (no. 1667); isotype (an immature plant) in U. S. National Herbarium, no. 1121953.

Dryopteris dumetorum belongs to the general group of *D. rudis* (Kunze) C. Chr., though it is not closely related to that species itself. Apparently it has no very near relatives; but the boundaries of this group as defined by Christensen are not very clear, and its dozen or so species need to be redescribed and compared on the basis of better material, the original specimen in several instances having lacked, for example, the rhizome.

ZOOLOGY.—*Geographical distribution of the nemerteans of the Pacific coast of North America, with descriptions of two new species.*[1] WESLEY R. COE, Scripps Institution of Oceanography. (Communicated by WALDO L. SCHMITT.)

An examination of the nemerteans in the collections of the United States National Museum revealed two species from the Pacific coast of North America believed to be new to science, in addition to many others from new localities. Most of them were dredged on the cruises of the U.S. Bureau of Fisheries steamer *Albatross* off the coasts of California, Washington, and Alaska and in the seas adjacent to the Japanese islands. These records are included in the following list, which shows the habitat and geographical distribution of each of the Pacific coast species so far as known at the present time. This list will supplement the data contained in the "Revision of the nemertean fauna of the Pacific coasts of North, Central and northern South America" (Coe, 1940). The total number of species now known from the Pacific coast of North America is increased to 99. Of these, 65 have been found only on the Pacific coast of North America, including Bering Sea and the adjacent Arctic coast of Alaska; 16 occur also on the coasts of Japan; 11 on the Atlantic coast of North America; 14 in European waters; 5 on South African shores; and 7 on the Pacific coast of South America.

Order PALEONEMERTEA
Family Tubulanidae

1. *Tubulanus albocinctus* Coe. Among red algae at depths of 100 to 200 meters; off coast of southern California.

2. *T. capistratus* Coe. Intertidal zone; coast of Alaska to Monterey Bay, Calif.; Japan. One specimen nearly a meter in length was collected by the *Albatross* in 1906 near Hakodate, Japan.

3. *T. cingulatus* Coe. Yes Bay, Behm Canal, Alaska, 290–400 meters; intertidal zone; Monterey Bay, Calif.

4. *T. frenatus* Coe. Intertidal zone; southern California.

5. *T. nothus* Bürger. Intertidal zone to 40 meters; coast of Alaska; South Africa; Mediterranean. The Alaska records are from preserved specimens only, and there remains the possibility they may actually have represented *T. annulatus* (Montagu), which is similar in markings and which is widely distributed on northern coasts from Greenland to Norway, Great Britain and the Mediterranean and has also been reported from South Africa.

6. *T. pellucidus* Coe. Intertidal zone; coasts of New England and southward; Monterey Bay to San Diego, Calif.

7. *T. polymorphus* (Renier). Intertidal zone; northern coasts of Europe; Mediterranean; Aleutian Islands, Alaska, British Columbia to Monterey Bay, Calif.

8. *T. sexlineatus* Griffin. Intertidal zone; Alaska to southern California.

9. *Carinomella lactea* Coe. Intertidal zone to 20 meters; Monterey Bay to San Diego, Calif. Burrowing form, found on sandy shores of boys.

Family Carinomidae

10. *Carinoma mutabilis* Griffin. Intertidal

[1] Contributions of the Scripps Institution of Oceanography, University of California, new ser., no. 216. Received October 27, 1943.

zone to 40 meters; British Columbia to Gulf of California. Burrows on sandy shores of bays.

Family Cephalothricidae

11. *Cephalothrix major* Coe. Intertidal zone; southern California.

12. *Procephalothrix spiralis* Coe. Intertidal zone to 20 meters; New England; Alaska to San Diego, Calif.

Order Heteronemertea
Family Baseodiscidae

13. *Baseodiscus delineatus* (Delle Chiaje). Widely distributed in both Northern and Southern Hemispheres; Mediterranean to Cape Verde Islands; Mauritius; Bermuda; Barbados; Fiji Islands; Chile; Japan; Gulf of California.

14. *B. delineatus* var. *curtus* (Hubr.). Coextensive with the preceding.

15. *B. mexicanus* Bürger. Gulf of California; west coasts of Mexico and Panama; Galápagos Islands; intertidal zone to 100 meters; among shells and corals.

16. *B. princeps* Coe. Alaska to Puget Sound; intertidal zone and off shore to depths of 50 meters or more; off Goloi Island, Alaska, 50 meters; off Oshima, Japan, 250 meters (*Albatross*); Sea of Japan 135–290 meters (*Albatross*); off Ose Saki, Japan, 260 meters (*Albatross*); south of Hokkaido, Japan, 340 meters (*Albatross*). This species was also found by Yamaoka (1940) in the intertidal zone at Hokkaido, Japan, but was erroneously assigned by him to *B. curtus* Hubr. Supplementing the original description by Coe (1901) it has since been ascertained that some individuals of *B. princeps* on the coast of Alaska and in Puget Sound have the lateral margins and ventral surface of the head white or colorless. These white areas disappear when the head is strongly contracted.

17. *B. punnetti* Coe. Monterey Bay to Gulf of California, Mexico; intertidal zone to 380 meters.

18. *Zygeupolia rubens* (Coe). Intertidal zone to 50 meters; southern New England and southward to North Carolina; Monterey Bay, Calif., to Ensenada, Mexico.

Family Lineidae

19. *Euborlasia maxima* Coe. Gulf of California.

20. *E. hancocki* Coe. Coasts of Mexico, Panama, and Peru; 17 to 100 meters.

21. *E. nigrocincta* Coe. San Francisco Bay, 20 meters; Monterey Bay, Calif., to Ensenada, Mexico; intertidal zone to 30 meters.

22. **Euborlasia variegata**, n. sp. This species was represented in a collection of nemerteans from Alaska by a headless fragment about 160 mm in length. The width of the body is 7 to 10 mm and the thickness 6 to 8 mm. The body is somewhat flattened in the middle intestinal region but becomes rounded posteriorly. The posterior extremity is rounded and without caudal cirrus.

This specimen is put on record because of the remarkable and distinctive coloration of the body. In spite of preservation in alcohol for about two years the color pattern is still conspicuous, consisting of an orange ground color, overlaid with bluish black longitudinal bands and transverse rings. On some portions of the body the black pigment covers most of the dorsal and ventral surfaces but in other portions it is confined to narrow rings which encircle the body. Several adjacent rings become wide and confluent on dorsal or ventral surface, or both, giving the appearance of broad, interrupted longitudinal bands connected by narrow lateral rings. This specimen represents a ripe female and the abundance of ova presumably influences the color pattern to some extent.

Sections show that the bluish-black pigment is confined to the cutis and that the pattern is formed by the relative thickness of the pigment layer, which is thin in certain areas and much thicker and denser in others. The epithelium and the muscular layers are colorless or yellow and the intestinal epithelium and ova deeper yellow or orange.

This specimen (U.S.N.M. 20633) was dredged at a depth of about 30 meters in Port Graham, Cook Inlet, Alaska, by Dr. Waldo L. Schmitt in connection with the Alaska King Crab Investigation, 1941.

23. *Lineus bilineatus* (Renier). Northern coasts of Europe; Mediterranean; Madeira; South Africa; Alaska to San Diego, Calif.

24. *L. flavescens* Coe. Southern California to Gulf of California, Mexico.

25. *L. geniculatus* (Delle Chiaje) (=*L. digueti* Joubin). Intertidal zone to 30 meters; Gulf of California; west coasts of Mexico and Panama; Mediterranean and Black Seas; west coast of Africa.

26. *L. pictifrons* Coe. Intertidal zone; Puget

Sound to coast of Mexico.

27. *L. ruber* (O. F. Müller). Intertidal zone to 10 meters; circumpolar; Siberia; northern coasts of Europe; Mediterranean: Madeira to South Africa; Greenland to southern New England; Alaska to Monterey Bay, Calif.

28. *L. rubescens* Coe. Monterey Bay to San Diego, Calif.

29. *L. torquatus* Coe. Coast of Alaska to San Francisco Bay.

30. *L. vegetus* Coe. Found in the intertidal zone beneath stones and decaying vegetation in estuaries, harbors and bays, as well as in crevices of rocks and among corallines and other growths exposed to the full force of the surf; sometimes above middle of intertidal zone; occasionally in brackish water. Commonly associated with dead barnacles and mollusks; feeds on ciliates and other small organisms, living or dead. San Francisco Bay, Calif., to Ensenada, Mexico. Reproduces asexually by fragmentation as well as sexually by fertilized eggs; has remarkable regenerative capacity.

31. *Micrura alaskensis* Coe. Intertidal zone; Prince William Sound, Alaska, to Ensenada, Mexico; Japan.

32. *M. impressa* (Stimpson). Bering Strait.

33. *M. nebulosa* Coe. Dredged at depths of 120–900 meters off the coasts of Alaska and California.

34. *M. nigrirostris* Coe. Among kelp holdfasts and other growths on rocks at low-water mark and below; southern California.

35. *M. olivaris* Coe. Monterey Bay and off San Francisco, Calif.; low-water mark to 120 meters.

36. *M. pardalis* Coe. Intertidal zone; Monterey Bay, California, to Ensenada, Mexico.

37. *M. verrilli* Coe. Intertidal zone and below; Alaska to Monterey Bay, Calif.

38. *M. wilsoni* Coe. Intertidal zone to 35 meters; Monterey Bay, California, to Gulf of California.

39. *Cerebratulus albifrons* Coe. Muddy flats between tide marks and below to depths of 100 meters or more; Alaska to San Diego, Calif.

40. *C. californiensis* Coe. On muddy shores and in bays to depths of 35 meters or more; Puget Sound to Gulf of California.

41. *C. herculeus* Coe. Bering Sea, coast of Alaska to central California and off the coast to depths of 60 meters or more.

42. *C. lineolatus* Coe. Muddy bays, southern California, Gulf of California and west coast of Mexico; intertidal zone to 70 meters or more.

43. *C. longiceps* Coe. Intertidal zone; Yakutat Bay, Alaska; off Oshima, Japan, 250 meters.

44. *C. marginatus* Renier. Sandy and muddy shores to depths of 100 meters; circumpolar; Norway to Madeira; Greenland and Labrador to Cape Cod; Alaska to San Diego, Calif.; Bering Sea (62°N. 173°W.), 70 meters; Japan.

45. *C. montgomeryi* Coe. Coast of Siberia; Bering Sea; Alaska to Monterey Bay, Calif.; Behm Canal, Alaska, 150–400 meters; Moss Cape, Belkofski Peninsula, 40 meters; off Hokkaido, Japan, 600 meters.

46. *C. occidentalis* Coe. Alaska to San Francisco Bay; off central California, 120 meters; Cold Bay, Alaska, 40 meters; Bellingham Bay, Wash., 20 meters; intertidal zone, Prince William Sound to Puget Sound.

47. *C. signatus* Coe. Bering Sea, 110 meters.

48. *Diplopleura vivesi* Joubin. Gulf of California, Mexico.

Order HOPLONEMERTEA
MONOSTYLIFERA
Family Emplectonematidae

49. *Emplectonema bürgeri* Coe. Intertidal zone to 500 meters; Alaska to Monterey Bay, Calif.; off Vancouver Island, 300 meters; Chatham Strait, Alaska, 500 meters; off Oshima, Japan, 250 meters.

50. *E. gracile* (Johnston). Northern coasts of Europe to Madeira; Aleutian Islands and coast of Alaska to Ensenada, Mexico; Chile; Kamchatka to Japan; intertidal zone to 100 meters. In many localities on northern coasts the most abundant of all species of nemerteans.

51. *E. purpuratum* Coe. Aleutian Islands.

52. *Nemertopsis gracilis* Coe. Intertidal zone and below; Puget Sound to Ensenada, Mexico.

52a. *N. gracilis* var. *bullocki* Coe. Intertidal zone; coast of central California.

53. *Paranemertes californica* Coe. Monterey Bay, Calif., to Ensenada, Mexico; in sandy and muddy bays.

54. *P. carnea* Coe. Intertidal zone; Alaska to Puget Sound.

55. *P. pallida* Coe. Intertidal zone; Alaska.

56. *P. peregrina* Coe. Commander Islands; Aleutian Islands, Alaska, to Gulf of California; Kamchatka to Japan. Intertidal zone and below, among mussels and other growths; often very abundant.

57. *Dichonemertes hartmanae* Coe. Intertidal zone; San Diego, Calif.

Family Carcinonematidae

58. *Carcinonemertes epialti* Coe. Commensal parasite on crabs of the genera *Portunus*, *Pugettia* and *Euphylax*. Monterey Bay to San Diego, Calif.; Peru.

Family Ototyphlonemertidae

59. *Ototyphlonemertes spiralis* Coe. On sandy shores of bays; San Diego, Calif.

Family Prosorhochmidae

60. *Prosorhochmus albidus* (Coe). Intertidal zone; Monterey Bay, Calif., to Ensenada, Mexico.

61. *Oerstedia dorsalis* (Abildg.). Intertidal zone and below; circumpolar; Norway to Mediterranean; Madeira; Nova Scotia to Florida; Puget Sound to Gulf of California.

Family Amphiporidae

62. *Zygonemertes albida* Coe. Intertidal zone; British Columbia to Ensenada, Mexico.

63. *Z. thalassima* Coe. Intertidal zone; Alaska.

64. *Z. virescens* (Verrill). Intertidal zone and below to depths of 120 meters; Bay of Fundy, New England and southward to North Carolina; Puget Sound to Gulf of California.

65. *Amphiporus angulatus* (Fabricius). Circumpolar; Greenland; Davis Strait; Labrador to Cape Cod; Bering Strait; Bering Sea; Aleutian Islands and Kamchatka to Japan; Alaska; British Columbia; Puget Sound and southward to Point Conception, Calif.

66. *A. bimaculatus* Coe. Intertidal zone; Alaska to Ensenada, Mexico; off San Diego, Calif., 250 meters; Okhotsk Sea, 140 meters.

67. *A. californicus* Coe. Intertidal zone to 80 meters or more; coast of southern California.

68. *A. cruentatus* Verrill. Intertidal zone to 80 meters or more; New England to Florida; Puget Sound to San Diego, Calif.

69. *A. flavescens* Coe. Monterey Bay, Calif., to Ensenada, Mexico.

70. *A. formidabilis* Griffin. Bering Island, Aleutian Islands, coast of Alaska and southward to Monterey Bay, California.

71. *A. fulvus* Coe. Intertidal zone to 85 meters; southern California.

72. *A. gelatinosus* Coe. The absence of the proboscis in the type specimen did not permit a satisfactory description of this species (Coe, 1905). Specimens collected by the U.S. Fish Commission have since become available for study and in these the proboscis proves to be typical for the genus *Amphiporus*. The basis is pear-shaped, of moderate proportions and not quite so long as the rather slender central stylet which measures 0.16 to 0.18 mm in length in an individual 150 mm long. There are four pouches of accessory stylets, with 4–5 stylets in each, and 15 to 17 proboscidial nerves. The body contains a larger proportion of gelatinous tissue than has been reported for any other species of the genus. Length of body 100 to 150 mm; width 10 to 16 mm.

Dredged at a depth of about 300 meters southwest of Kodiak Island, Alaska; at 400 to 450 meters in Clarence Strait; at 40 meters near Port Townsend, Wash., and at 130 meters in Uraga Strait, Japan.

73. *A. imparispinosus* Griffin. Intertidal zone to 50 meters; coast of Siberia, Bering Sea, Alaska to San Diego, Calif., and Ensenada, Mexico. Abundant in many localities.

73a. *A. imparispinosus* var. *similis* Coe. Differs from the typical form in having 2, instead of 3, pouches of accessory stylets. Puget Sound to Ensenada, Mexico.

74. *A. macracanthus* Coe. Dredged in the Arctic Ocean off the northern coast of Alaska.

75. **Amphiporus maculosus**, n. sp. This species is distinguishable from others of the genus by the reddish brown spots and blotches on the dorsal surface. Another species, *A. nebulosus* Coe, has the dorsal surface more nearly covered with confluent dark brown spots and blotches, while in *A. maculosus* they are widely separated. *A. nebulosus* has 18 to 25 ocelli on each side of head but in the only specimen of *A. maculosus* available for study ocelli could not be detected. The stylet basis in *A. nebulosus* is much swollen posteriorly and about as long as the stylet, while in *A. maculosus* it is only moderately enlarged posteriorly and much longer than stylet. The nephridia, caecal diverticula and proboscis show minor anatomical differences.

Body moderately slender, narrowed posteriorly; head with inconspicuous oblique grooves. Length of type specimen 36 mm, width 3 mm, thickness 2 mm after preservation.

Color of body pale gray, with numerous reddish brown spots and blotches on dorsal surface; head without spots. These markings vary

in size from dots to large blotches, usually separated by much larger spaces without pigment. The spots in this specimen cover less than one-third the dorsal surface. Ventral surface pale gray.

Ocelli could not be detected either in the specimen cleared in oil or in the sections.

Proboscis sheath extends entire length of body. Proboscis large, stylet basis pear-shaped, about twice as wide posteriorly as anteriorly and twice as long as the posterior diameter. Central stylet two-thirds as long as basis. In this specimen there are 18 large proboscidial nerves. Each of the two accessory stylet pouches contains three stylets.

Cerebral sense organs large, situated anterior to brain, each with a relatively large canal leading anteriorly to an oblique groove on lateroventral surface near tip of head. Cephalic glands voluminous.

Nephridia extend anteriorly as far as posterior borders of cerebral ganglia. Intestinal caecum extends forward on ventral side of pylorus but terminates some distance posterior to brain; caecal diverticula short, not reaching brain. Gonads more numerous than intestinal diverticula; oviducts open ventrolaterally.

The single known specimen was collected at Lagoon Reef, St. Paul Island, Bering Sea. Type, U.S.N.M. no. 16797.

76. *A. nebulosus* Coe. Intertidal zone; coasts of Alaska and Japan.

77. *A. occidentalis* Coe. Dredged at depths of 70 to 170 meters off the coast of Washington.

78. *A. pacificus* Coe. Dredged at depths of 70 to 180 meters in the Bering Sea and off the coasts of Washington and California. In two specimens from Bering Sea the ocelli are more numerous than figured by Coe (1895) and are arranged in two groups on each side of head. The anterior, marginal, group on each side consists of about 10 large and 8 smaller ocelli, while the posterior, cerebral, group has about 8 large and 6 small ocelli. Most of the cups of those in the marginal groups are directed forward and those of the cerebral groups backward.

79. *A. paulinus* Punnett. Pribilof Islands, Bering Sea.

80. *A. punctatulus* Coe. Intertidal zone; Catalina Island, Calif.

81. *A. rubellus* Coe. Intertidal zone to 200 meters; coast of southern California.

82. *A. tigrinus* Coe. Intertidal zone; British Columbia and Puget Sound.

Family Tetrastemmatidae

83. *Amphinemertes caeca* Coe. Dredged with tunicates at a depth of 5 meters; Kodiak Island, Alaska.

84. *Tetrastemma aberrans* Coe. Intertidal zone; coast of Alaska.

85. *T. bicolor* Coe. Shallow water; Kodiak Island, Alaska.

86. *T. bilineatum* Coe. Intertidal zone; San Diego, California.

87. *T. candidum* (Müller). Circumpolar; Greenland and Norway to Madeira; South Africa; Labrador to New England and southward; Alaska to Ensenada, Mexico.

88. *T. nigrifrons* Coe. Intertidal zone; Puget Sound to coasts of Mexico and Costa Rica; Japan.

89. *T. quadrilineatum* Coe. Intertidal zone; Monterey Bay, Calif. to Ensenada, Mexico.

90. *T. reticulatum* Coe. Southern California; intertidal zone.

91. *T. sexlineatum* Coe. Dredged at a depth of 35 meters near San Clemente Island, Calif.

92. *T. signifer* Coe. Intertidal zone to 10 meters; Monterey Bay to San Diego, Calif.; locally common on kelp holdfasts.

POLYSTYLIFERA REPTANTIA

Family Drepanophoridae

93. *Drepanophorus crassus* (Quatrefages). Dredged at depths of 2 to 100 meters or more; Arctic Ocean; European coasts; tropical Pacific islands; Cape San Lucas, Mexico; Panama; West Indies; Peru.

94. *D. ritteri* Coe. Dredged at depths of 50 to 300 meters off coast of southern California.

POLYSTYLIFERA PELAGICA

Family Planktonemertidae

95. *Planktonemertes agassizii* Woodworth. Bathypelagic at depths of 1000 meters or more off coasts of Panama and Ecuador.

Family Nectonemertidae

96. *Nectonemertes pelagica* Cravens and Heath. Bathypelagic at depths of 100 meters or more off coasts of California and northern South America.

Family Pelagonemertidae

97. *Pelagonemertes brinkmanni* Coe. Bathypelagic at depths of 600 meters or more. Bering Sea and off coasts of Alaska, Aleutian Islands and Kamchatka.

Family Dinonemertidae

98. *Dinonemertes mollis* Coe. Bathypelagic at depths of 600 meters or more; off coast of Mexico.

Order Bdellonemertea
Family Malacobdellidae

99. *Malacobdella grossa* (Müller). Commensal in various species of bivalve mollusks. Northern coasts of Europe, Mediterranean; Nova Scotia to Chesapeake Bay; Puget Sound to California.

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Obituary

The premature death of Charles Elmer Resser, on September 18, 1943, at the age of 54, deprived the Academy of one of its newest members. Born in East Berlin, Pa., on April 28, 1889, young Resser grew up in country underlain by the Cambrian rocks and fossils to which he devoted much of his later life. He graduated from Pennsylvania State Teachers College in 1912 and in 1913 received his A.B. degree from Franklin and Marshall College. Here he came under the influence of the inspiring geologist, Justin Roddy, who imparted his enthusiasm for fossils and the earth sciences to his student.

In 1914 Dr. Resser became assistant to Charles D. Walcott, great student of the Cambrian. Working under this mentor for some years, he received his paleontological training and his wide knowledge of the Cambrian period and its fossils. In 1915 he became assistant curator of paleontology in the U. S. National Museum and associate curator in 1923. From 1929 until his death he held the title of curator of stratigraphic paleontology.

Although Dr. Resser's practical training was received under Walcott, he continued his more formal education at Princeton and George Washington Universities, receiving the Ph.D. degree from the latter in 1917. In 1915 he was appointed part-time instructor in geology and geography in the George Washington University and was advanced to assistant professor in 1923. This position was relinquished in 1932. Dr. Resser also taught geology in the University of Maryland for several years.

After the death of Walcott in 1927, Dr. Resser became custodian of the Cambrian collections and devoted most of his time to research on the fossils and stratigraphy of this period. He made field investigations in the Great Basin, Rocky Mountains, and Canadian Rockies and in his later years made several trips into the southern Appalachians to study Cambrian strata. Two visits were made to Europe for the same purpose. This concentrated effort on one period of time gave Dr. Resser a knowledge of Cambrian fossils, particularly trilobites, which enabled him to see relationships between strata in this country and abroad that had hitherto been unsuspected. His untimely death abruptly terminated several ambitious programs that would have brought to fruition the results of his life's studies.

Although Dr. Resser's scientific interest lay in Cambrian fossils, he was perhaps equally devoted to the service of his fellow men through his activities in church and educational affairs. He was long time president of the District of Columbia Sunday School Association, a member of the Board of the Central Union Mission, and chairman of the Board of Trustees of the Washington City Church of the Brethren. He was a member of the Board of Trustees of Bridgewater College and was active in behalf of other colleges of his church.

Foremost of Dr. Resser's honors was the D.Sc. conferred by his alma mater, Franklin and Marshall College, in 1934. He was a fellow of the Geological Society of America and a member of Sigma Gamma Epsilon.

In 1908 Dr. Resser married Anna M. Evans, who, with his two children, Harold and Mrs. Helen R. Yates, survives him. By his death Christianity has lost a devoted servant and geology and the Academy a member who was not granted time to fulfill his best promise. His affable disposition and kindly ways will be missed by all his friends.

G. A. Cooper

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JOURNAL
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ETHNOLOGY.—*Western Mediterranean island names and survival of Arabic's most divergent dialect.*[1] JOHN P. HARRINGTON, Bureau of American Ethnology, and GEORGE M. BARAKAT, Board of Economic Warfare. (Communicated by M. W. STIRLING.)

The present article has as its aim the assembling and placing on record the latest and most accurate information on the names of certain sizable islands of the western half of the Mediterranean Sea, mentioning the high points of the linguistic and other history of these, and at its end the outlining in some detail of the survival on the Maltese Archipelago of what is Arabic's most divergent dialect or language, one curiously beset with Italian. The island name etymologies include that of the Arabic name of Etna Mountain, Sicily's prominent geographical feature. Original expatiation on Maltese Arabic has been curtailed to save space. Grateful acknowledgment is due to J. Whatmough, professor of comparative philology, Harvard University; Philip K. Hitti, professor of Oriental languages and literatures, Princeton University; Julian H. Bonfante, professor of Italian language and literature, Princeton University; Mario A. Pei, Department of Romance Languages, Columbia University; Arthur Jeffery, professor of Semitic languages, Columbia University; Elio Gianturco, Law Library, Library of Congress; Habib Kurani, Office of War Information; A. B. Antar, Office of War Information; and several others. Henry B. Collins, Jr., Bureau of American Ethnology, contributed a bibliography. Especially are we obligated to Professor Hitti, speaker of Arabic, who became independently interested and turned over to us his notes on the mention of Pantelleria Island in the geography of Yaaquut; to Professor Bonfante, who has written us four times; to Dr. Kurani, who contributed the unique etymology of the Arabic name of Etna; and to Mr. Antar, who has furnished clippings and has assisted on ten different points. Mr. Gianturco, who talks Italian as his mother tongue and has an unusual knowledge of Latin, has helped in a negative way more than in a positive one. Realizing that all etymologies go back only a jog, he has had fun even with our triumphs. For instance, the famous city of western Sicily is known in Italian as Palermo; its name crops up in Greek, even in Modern Greek, as Pánormos, which sounds in Greek exactly as if it means very much of a harbor, being formed like pán-agathos, good indeed. But it has for years bothered Gianturco to know *why* Italian has in this name a form that shows no nicety of conformity with the Greek. At last he mustered sufficient courage to ask Dr. Herbert H. Vaughan, Department of Romance Languages, University of California, how the change came about—and was told: the Saracens brought it about! It is possible that Pánormos is a corruption of an aboriginal language land name and is not Greek or Italian at all. We are indebted especially to Professor Hitti and to Mr. Antar for their independent finding of the articles by Dr. Bernard Lewis in the *Arabic Listener* and in the Rabat newspaper *Es-Sa'aada.* Dr. Hitti copied passages from the same in his own hand, and Mr. Antar translated all of the same prior to the incorporation of important points into the present article. Finally, Dr. Kurani, whose knowledge is

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better than any dictionary because based on wide reading of Egyptian and other newspapers, checked on all the Arabic names of places herein, and his checking was verified by Arabic dictionaries and, on top of this, thoroughly by the researches of Paul Vogenitz.

Throughout the following it should be borne in mind that not only Greek and Latin island names, but also Arabic, are feminine.

Spellings with y and with the macron of Latin names taken over from the Greek have been in some few instances retained for practical purposes.

THE MEDITERRANEAN SEA

By far the largest sea on the face of the earth, with exception of island-bounded ones, is the Mediterranean of the Old World, by its vast saltwater-filled depression all but separating Eurasia and Africa. Leading off from the Mediterranean to the north are the wide-mouthed Adriatic Sea and the narrow-mouthed Black Sea; whereas the Caspian Sea, formed by a depression similar to that which originated the Mediterranean, is landlocked and is not connected with the Mediterranean at all. The Sahara Desert, some distance south of the Mediterranean and paralleling it in its extension across northern Africa, lies partly below ocean level and would if filled with water become what might be termed a second and more southerly Mediterranean Sea. The strangest fact about the Mediterranean Sea, as regards languages, is that it is nameless. In the most various languages it is merely referred to as the sea. Basque itxaso, also itsaso, Latin mare, Phoenician *yaam, Arabic baḥr, Ancient Egyptian im, Tuareg Berber egeriu—all mean "sea" and are used of the Mediterranean. If the speaker wishes to be specific, the sea is described as the sea here, the southern sea, the northern sea, our sea, or the like. Thus Arabic sometimes says baḥr-nə, our sea. The name Mediterranean itself is in origin a description, saying the sea amid the lands. Ancient Egyptian Uatch-ur, god of the Mediterranean Sea, is the only example we can find of the Mediterranean appearing as a named divinity. There was no general name of the lands of the northern shore of the Mediterranean, or to any extent of the eastern shore, but there was a name for the southern shore. Ancient Egyptian applied Lebu to the region west of Egypt, and Greek shows this same word in its Libúee, which was applied by the Greeks to northern Africa west of Egypt, an application still more or less followed in Latin with the Latin spelling Libya, although the term Africa, applied to all the region south of the Mediterranean became the general designation, and in Italian Libia is restricted to the region just west of Egypt. To Arabic speakers, all north Africa west of Egypt was, and is, Maγrib, a term which also means the west in general. The Strait of Gibraltar, narrow outlet of the Mediterranean, was known to the Greeks as the Pillars of Hercules, but the Phoenician name of the Strait of Gibraltar is unknown.

The portion of the Mediterranean Sea comprised between the islands of Corsica, Sardinia, and Sicily and the peninsula of Italy was known among other names to the ancient Greeks as Tuurreenâios Pélagos, alias Tuurreenikôs Pélagos, meaning the Etruscan Sea, taken into Latin as Mare Tȳrrhēnum, and is standardized in Italian as Mar Tirreno, and in English as the Tyrrhenian Sea.

GENERAL HISTORICAL BACKGROUND

Before the names of the islands of the western Mediterranean are presented, a preliminary anchoring should be gained in the general history of the region, for this history has everywhere been much the same.

The islands were at the dawn of written history, and doubtless during long prehistorical times, inhabited by populations speaking languages that early became extinct as a result of military conquest. Not one of the aboriginal island languages has survived even to the extent of going on inscriptional record, but each of them has no doubt left topographical and gentilitious names, or words used as names, and perhaps other words as well, incorporated into the language of newer comers. Some of these words are at the present remote date no doubt still existent, but only in a battered and bartered form which is indefinite for linguistic purposes. Parallelism would sug-

gest that diversity of language, possibly to the extent of there having been two or several stocks, obtained on the islands. There may have been a condition like the string of vastly diversified Berber languages which extended along the north African coast until driven inland by the Arabs, where the Berber languages still obtain.

But the archeology of the western Mediterranean insular peoples is not questionable or silent. Stone towers and other structures still stand or have been uncovered. Excavation has already yielded temples and the artifacting of cultures from nonscriptorial times, while future ages will vastly increase and definitize this archeological record. Aboriginal insular blood doubtless also persists on each of the islands.

There came to these islands two Semitic thrusts from the far-away eastern end of the Mediterranean, where the so-called Semitic family of languages obtained, both of them of course water-borne. The first of these was the Phoenician thrust, very early in origin, starting from the region of Tyre and impelled by trade and colonization; the second was the Arabic, also known as the Saracen, thrust, originating at the close of what is known to European historians as the Early Middle Ages, starting from inner Arabia, largely land-borne, and impelled by religion and colonization.

It is one of the minor aims of this paper to present a new etymology of the word Phoenician, worked out by the senior author. Greek Phôinix, m, Phoenician, genitive Phôiniikos, feminine Phôiniissa, is the standardized form of ancient Greek and survives into modern Greek, in which latter the vowel of the penult is, however, short, the pronunciation being Fínix, m, genitive Fínikos. Latin Poenus, later Puunus, m, Phoenician, diminutive noun Puunulus, adjective Puunicus, stipulates an unrecorded ancient Greek *Phôinos, m, Phoenician, adjective *Phóinikos, lacking the -iik- formative and therefore being what in Greek would be called heteroclitic, just as the Messapian language of ancient Italy had pános, m, bread, versus Latin panis, m, bread, and Gothic, a North Germanic language, had fisks (earlier *piskos), m, fish, versus Latin piscis, m, fish. One of the common Greek words for red was phôinix; and if one looks up red in Yonge's English-Greek dictionary, phôinix will be found to lead off the entry of equivalent words. Phoiniikó-pedos, m, lit. red-bottomed, was one of the Greek terms for the Red Sea, and phoiniikó-pteros, m, lit. red-feathered, is indicated by ancient Egyptian to have been the Greek word for the ibis of Egypt, the ancient Egyptian for ibis meaning red. It has been generally accepted that Phôinix was applied to Phoenician because of tawny or ruddy appearance, but our new etymology is that the term was applied because of the association of the Phoenician with the snail crimson industry.

Brief mention should be made here of this industry, which had its headquarters among the Phoenicians at Tyre and to which a Phoenician was by the Greeks at sight, or at mention, aligned. Several species of snail could be used, but notably two species of the genus *Murex* were concerned. Greek seafarers early ran into Phoenician sea-farers, the latter engaged in gathering snails. Pliny describes in Latin the details of the dyeing process by which a sort of pus secretion of the head of the snail was made to produce encrimsoned cloth of a color known to the ancients as royal "purple." One gets the impression in reading this account that the coloring was sometimes dim or unsuccessful. Snail encrimsoning was largely abandoned already in the Middle Ages, and modern analine and cochineal dyeing has relegated it to merely historical curiosity. The snail species, however, still survive, and are well known, having, according to communication received from Dr. Paul Bartsch, United States National Museum, been thoroughly studied by conchcologists.

As to the anterior history of the word *Phôinos alias Phôinix, we can point out only that this word does not occur in what fragmentary Phoenician language recordings we possess, nor does it occur in the closely related Hebrew, from which we have a much larger fund of words. Nor is it the ancient Egyptian word for Phoenician or Phoenicia. One can not say anything about commonness of occurrence as regards such a

language as ancient Egyptian, where we are fortunate to get any occurrence at all, but there occurs in Egyptian Poun-t, Arabia, including the lands of the Persian Gulf, and since -t is a feminine postfix, one can well perceive in Poun- a possible source of Greek *Phôinos. Egyptian Tchah, also Kefti, are the names of Phoenicia. On record also are Egyptian Kharu, Syria, and Rethenu, Syria and Palestine together. It may be that Greek *Phôinos is an Oriental word in origin, but what we actually know is that it meant in Greek evidently dyester, and if assumption of Greek origin is correct derivation may well have been from Greek phónos, murder, Aryan *ɢhwónos, for there occurs in Greek phoinós, for *ɢhwon-yó-s, poetical, red with blood. If Greek derivations are here in order, one can also get *Phôinos from phoitáoo, to rove, a new etymology proposed by the senior author.

Phoenician inscriptions indicate that the Phoenicians never referred to themselves as Phoenicians, but as Canaanites, and fortunately we know considerable about the Canaanites from non-Phoenician sources. The Phoenician language was termed by the Phoenicians themselves Canaanitic.

The Phoenicians' first Mediterranean island conquest was Cyprus, a large island of the eastern part of the Sea in front of Tyre and therefore outside the field of the present article. Their subsequent and greatest conquest was not an island, but the planting of Carthage on the north African coast in what is now called Tunisia, for which purpose a native Berber-speaking population had to be dealt with. This colony of Carthage, which became a vast city eclipsing even the mother Tyre itself, was apparently known to the Phoenicians only by the descriptive term Qert Ḥaadaašt, meaning the new city, the first word meaning city and the second meaning new. This name was too much in its sounds for either Greek or Latin, and the standardized Greek corruption became Karkhedóon, the Latin Cart(h)aago. One casts about, according to the training of philology, to discover some other word in Latin toward which the foreign name became assimilated, and thinks at once of Latin caartilaago, cartilage. Both Cartaago and caartilaago are feminine and are phonetically much alike. In later Phoenician history it became hard to say whether colonization of islands was perpetrated from Tyre or from Carthage, or from both. Eastern Spain became a powerful Phoenician center, and one of the towns established there was known as the new new-city, in Latin as Cartaago Nova, to which the Spanish descendant form, Cartágena, still in use and applied to the same settlement, bears interesting testimony.

The Phoenician name of the inner harbor of Carthage is also known to us. It was Qaaṭoon, lit. the small one, corrupted and standardized in Greek as Kóothoon and having nothing to do with the name Carthage.

The Mediterranean was during a long period a Phoenician lake, and since history comes to us from Greek and Latin we are left largely in the dark as to Phoenician history. It can be safely assumed, however, that the Phoenicians in the history of many of the islands preceded the Greeks, but whether as mere traders or as linguistic supplanters is a matter to be determined by archeology and history of each individual island, and is sometimes only to be surmised. The Phoenicians very occasionally ventured beyond the Strait of Gibraltar to trade with the Britain or Ireland barbarian inhabitants, where they could have been described as Mediterraneans.

The account of the so-called Punic wars between Rome and Carthage is one of the chapters best known in history. The second Punic War, terminating in 202 B.C., left the Phoenicians with only Africa, and the Third Punic War, ending in 146 B.C., put an end to Carthage. The war culminated in five days of frenzied street fighting in the city of Carthage. Phoenician mastery of the Mediterranean was followed by Roman.

As has been stated above the Phoenician language was Canaanitic, so similar to Hebrew that a speaker of one language could with a little practice understand the other. As history has turned out, the most remarkable fact about the Phoenician language is that it gave the alphabet to Greek, thus causing Greek to become a written language. Not only Greek but also Latin and Etruscan became written languages,

written in forms of the Greek alphabet. Western Phoenician disappeared with the fall of Carthage, but in the east Phoenician lingered on, and it is not known just when it became extinct. Phoenician became supplanted by Latin in the west, by Aramaic in the east.

Arabic Fiiniiqii, adj, Phoenician, plural Fiiniiqiiyiin, simply shows an Arabicized form of the Greek.

The second Semitic wave, like the first, was largely anchored to northern Africa but originated in the religious movement of Mohammed, 570–632 A.D. The name Mohammed, in Arabic Muḥammad meaning the elevated one, is one of the most famous in history, his hegira, or flight, from which Mohammedans date their era, having occurred in 632. Semitic, in a form different from Phoenician, was carried west more thoroughly than the Phoenicians had ever carried it, to supplant the endemic languages of the entire coast of north Africa and to be spoken by a ruling class throughout the southern half of Spain and the large islands of the western Mediterranean. The entire Iberian Peninsula was known in Arabic as Al-Andalus, whereas in Spanish Andaluz, andaluz means only Andalusian and the former province was called Andalucía, English Andalusia. The Arabic is from the Spanish, and the Spanish is from alow Latin *Vandaluuc, the Latin gentilitious noun being Vandalus, and this for Vandalic *Wandils, expressly determined by Pliny to have meant rover. In Arabic-speaking northern Africa, poetry was written about Al-Andalus. The Arabic language, carried west, broke up in course of time into separate dialects or languages, and there came into being west of Egypt 11 varieties: (1) Hispano-Arabic, (2) Balearic, (3) Moroccan, (4) Algerian (including Tunisian), (5) Corsican, (6) Sardinian, (7) Sicilian, (8) Pantellerian, (9) Lampedusan, (10) Maltese, and (11) Libyan. All these were known collectively in Arabic as the tongues of the Maγrib, also transliterated Maγreb, that is, the tongues of the West. Numbers 1, 2, 5, 6, 7, 8 and 9 are extinct, having yielded in every instance to some variety or another of Latin-derived Romance language.

In Arabic the generic name of the language as a whole, and the name of any one of these languages or dialects, is ʿArabii.

How Latin-originated Romance came into several of the islands causing extinction of Arabic is a matter of individual island history, one about which thick volumes can be written. Of all the islands, only on Malta and adjacent Gozo does Arabic survive.

THE BALEARIC ISLANDS

The Balearic Islands are situated in the central part of the sea off the eastern coast of Spain and southeast of the large Catalonian-speaking city of Barcelona. The Balearic islands of size are four in number: Majorca, Minorca, Iviza, and Formentera; in Spanish: Mallorca, Menorca, Ibiza, and Formentera; in Catalonian the same as in Spanish except that the name of the third-mentioned island is spelled Ibiça. The Balearic islands constitute the Spanish province of Baleares, but the older usage is to apply the Spanish term Baleares to Majorca and Minorca Islands only and to apply the Spanish term Pitiuses to Iviza and Formentera.

Greek Gumneesíos is the adjective meaning Balearic inanimate or animate. The masculine plural is what is mostly in use referring to the aboriginals or natives, while the islands are termed Gumneesíai Nêesoi. Although expressly told that this term refers to the custom of the aborigines of going naked during the summer seasons, there was in ancient times a contradictory and evidently incorrect etymology to the effect that the name was a memory of a vigorous light-armed defense which the islanders put up against early Greek invaders, connecting the term with Greek gumnées, light-armed soldier, and a form Gumnéetides Nêesoi, the adjective being as from a singular Gumnêetis, is also occurrent in Greek. Gumneesíos is derivative to Greek gumnós, naked, and this last is surely for *nugwnós. In Greek, the adjectives Baleaarís, Baleaaréus, and Baleaarikós are also on record. Some of the Greek forms have i for e, as do also the forms of Latin, or the second vowel is omitted altogether. Gumneesíos is the standard Greek term.

The Greek term, with the spelling Gymnēsius, occurs in Latin, but the regular Latin term is: Baleaaris, Baleaaricus, adj, Balearic, also with i for e in these, or with omission of the second vowel, and this name also occurs in Greek, but with an impromi-nency comparable to that of Gumneesíos in Latin. From Latin descends Spanish Balear, balear, adj., Balearic; Catalonian ditto. Spanish speaks of las islas baleares, Catalonian of les illes baleares. A pronunciation occurring in several of the Spanish dialects and notably that of American Spanish is: Balyar, balyar. Since Latin Baleaaris has no known etymology, it may have its provenience from the aboriginal language or languages of the Balearic Islands, which may have been allied to Berber, or indeed to Basque. Basque does not assist toward etymology of Latin Baleaaris. Basque has borrowed the Spanish or Catalonian word.

Arabic Balyaar, f, a Balearic island, plural Balyaaraat, is from Romance. The common Arabic adjective is Balyaarii, pertaining to a Balearic entity, plural Balyaari-iyiin. The Balearic Islands are called in Arabic Djazaa'ir Al-Balyaaraat, but better Arabic for them is, according to Dr. Kurani, simply Djazaa'ir Al-Balyaar. The olden, and still somewhat used, Arabic term for the Balearic Islands is: Al-Djazaa'ir Aš-Šarqiiya(h), lit. the Eastern Islands.

We shall probably never know the earlier names, if there were any, of the larger two Balearic Islands. These islands were referred to in Greek merely by descriptive terms: Méizoon, f, larger, and Méioon, f, smaller, in Latin by Maajor, f, larger, and Minor, f, smaller, comparatives of the Greek and Latin adjectives for large and small, respectively. Only in late Latin do we find Maajoorica and Minoorica, these being feminines of adjectives in -ic- and formed exactly like Latin Corsica. We have above given the standard Spanish corruptions of these Latin descriptive names and have stated that the Catalonian descendants are the same. The noteworthy fact is that the name of the larger island has in its Spanish and Catalonian form, ll, although Spanish has mayor, Catalonian major, larger, and one should in this connection notice that Catalonian majorca equals Spanish mazorca, ear of corn. That an older usage was to confine the term Balearics to these two islands has also been mentioned above.

One also says in Arabic Al-Kubra(y), The Larger, and As-Suγra(y), The Smaller, of Majorca and Minorca, respectively, but the usual Arabic designations are Mayurqa(h) and Minurqa(h), from the Romance.

In contradistinction to Majorca and Minorca, there was a Greek adjective pituóeis, piny, from Greek pítus, f, pine, equated to Latin piinus, f, pine in Greek-Latin dictionaries, applied by the Greeks to the group of islands consisting principally of Iviza and Formentera, since this group was in part covered with coniferous trees. The Greek feminine plural as Pituôussai, uncontracted Pituóessai, the piny ones, Latinized as Pityūsae, and in Spanish Pitiuses, showing simplification of Greek double s into single s of Latin, as in several such names. This Greek group name would be rendered in Latin as Piineae, but the Greek name was taken over bodily into Latin and was never translated. Greek Pituôussa was also the name of two different piny islands located elsewhere. Knoche (Herman), Flora Balearica, vol. 1, pp. 270–271, Montpellier, 1921, states that there are two species of the family Pinaceae on Iviza Island: (1) *Pinus pinea* L., concerning which he quotes Barcelo as follows: "In montosis aridis Ivizae frequens, le bois de cet arbre employé dans la construction des navires"; and (2) *Pinus halepensis* Mill., stated to be commoner on Iviza, at least at the present time, than *P. pinea*. Evidently both of these species were termed by the Greeks pítus.

The only name of one of the Balearic Islands that may be of native insular origin is Iviza. The name of this island is recorded in Greek in four spellings: Ébesos, Ébusos, Ébousos, and Ébosos. Ebousâios is one of the possible adjectives that can be formed in Greek. Latin shows Ebusus, Eboosiia, while an adjective on record from Pliny is Ebusitaanus. We have in a Phoenician inscription Ibrusim, which has been conjectured to be a plural versus Greek Ébesos, r being accounted for as possibly due to

Libyan pronunciation of Phoenician. Iviza is not only the name of the island but of the town on the island. In the museum at Iviza town there are on exhibit Phoenician and other local finds.

The Arabic is Ibisa(h), from the Romance.

Just south of Iviza is the still smaller island of Formentera. There is on record in the Greek dictionaries designation of three different islands by the term snaky, and Formentera is the island of the Balearic group designated by this name. Greek ophióeis, adj., snaky, from óphis, snake, has as its feminine ophioûssa, uncontracted ophióessa, the snaky one, and this is the Greek name of Formentera Island. Latin merely imitated Greek spelling the name Ophiūsa. The real, or earlier, name will probably never be known. The island emerges in modern times under the name Formentera, a name like the ancient one merely descriptive, but unlike the name Pantelleria, which we shall consider below, having an easy etymology. The ordinary Catalonian word for wheat is blat, m, but there is also a word forment, m, which is used mostly in two couplings: forment candial, Spanish trigo candeal, summer wheat, and forment rotg alias forment rojal, Spanish rubión, red wheat. Blat can be substituted for forment in these two expressions. Catalonian forment is from Latin fruumentum, n, grain. Catalonian formentera, f, means wheat granary, translatable into Spanish as triguera, and with this one can compare Spanish Granada, literally granary.

The Phoenicians probably reached the Balearic Islands before the Greeks, and Phoenician language inscriptions have been found there. But it is uncertain whether the Phoenician language ousted the aboriginal one, or ones. Not knowing whether a native, Phoenician, or Greek language obtained in the islands at the time, we have information that Latin was introduced into the islands subsequent to the fall of Carthage, and this doubtless developed into the dialect of Catalonian that still obtains on the Balearics. The definite article of this dialect begins with s-, from Latin ipse, a feature common to Sardinian Italian dialects. When Arabic speakers entered southern Spain from Africa in 711 A.D. and established a kingdom there, the Balearic Islands remained untouched, and it was not until 903 that a Hispano-Arabic expedition from Cordova conquered the islands, if one can judge from analogy with the history of southern Spain and of Corsica certainly not extinguishing the Latin-based language. In 1203 the Balearic Islands became an independent kingdom with the help of the Aragonese of northeastern Spain, so that the conquest of the Spanish over the speakers of Arabic in Spain in 1492 had no effect on the Balearic islanders.

CORSICA

Greek Kúrnos, Kurnía, Korsís, f, Corsica. Greek adjectives are Kúrnios, Kurnâios, and others. Latin follows Greek in showing Corsis, but also Corsica (originally the feminine of an adjective; compare Latin Maajoorica, Minoorica), and the name Corsica persists in modern Italian. Corsica persists as the standard name in Italian. But Italian has as its adjective corso. French has Corse, corse, both as the name of the island and as the adjective, the island name being derivable from Latin Corsis. One can see in these forms possibly the batterings from a native name of the island, from some place name of the island, or from some term for inhabitant.

Arabic Kursika('), Kursika(h), from Italian.

The earliest surmised inhabitants of Corsica possibly spoke Ligurian, tongue of the nearby mainland coast to the north. These were followed in succession by Greeks, Etruscans, Phoenicians, and Romans. Arabs, said to have come from Spain, conquered Corsica in 810, about a century before the Balearic Islands were conquered, but lost Corsica again about 930. At the present time, the island of Corsica constitutes the Department of Corsica, which is a department of France.

SARDINIA

Greek Sardóo, f, declined like Sapphóo, name of the poetess, also less standardly Sardóon, f, and Sardónos, f. The Greek adjective is Sárdos, as well as other forms.

Latin Sardinia, adjective Sardus. Italian Sardegna, adjective Sardo. Perhaps Sárdos is the more original appearance and from some insular term.

Arabic Sardinya('), Sardinya(h), from Latin and Italian.

Sardinia has had, like Corsica, a long and motley succession of ethnic occupants.

SICILY

Sicily is the largest island of the Mediterranean. The eastern coast of Sicily was very early colonized by Greeks, while the western part of Sicily was colonized and held by Phoenicians. Wars between these two ethnic groups were carried on for generations. The Greek colonies were first started in 735 B.C., the term for the variety of eastern Sicilian aboriginal tribesman encountered by the Greeks being Sikelós. Ancient accounts also give another suspiciously similar sounding term: Sikanós. From Sikelós the Greeks coined a name for the eastern part of Sicily and for the whole island: Sikelía, from which came Latin Sicilia and from this Italian Sicilia (of same spelling but of different pronunciation). The Greek colonists also formed a term for the whole island: Triinakría, literally the three-cornered one, which may have had a short vowel in the first syllable. The regular Greek adjective for three-cornered was, in contrast, trígoonos.

According to Greek source, the Phoenicians first appeared in Sicily in 536 B.C. Greek and Phoenician languages may have caused extinction of the aboriginal tongue, or tongues, of Sicily. With the winning of the Second Punic War, Sicily became Rome's earliest province. The Latin language became established there and through the centuries became the Sicilian dialect of Italian, but not to the doing away with Greek until something like 1700 A.D.

Arabic Ṣiqliya(h), Sicily, an old borrowing from Greek and Latin and from Romance before the k or c was fronted, a word considerably used in Arabic. One should notice the emphatic initial ṣ, which keeps company with the q.

With the fall of the Roman Empire, Sicily became part of the Vandal kingdom, later of the Visigothic. Later Sicily went with the Eastern Empire, which perhaps pleased the Greek-speaking colonists of the eastern shore. Then came the Arabian period of Sicilian history, concerning which there is a 3-volume work by Amari giving sources in Arabic. The article in the Rabat, Morocco, newspaper *Es-Sa'aada* under date of July 5, 1943, is translated by Mr. Antar in part as follows:

> The Arabs occupied Sicily in the year 827 A.D., during the time of Ma'awya Ibn Sefyaan. During that period one of the Sicilians had rebelled against the Byzantine governor and had asked for aid from Ziyaada Al-Aγlabii, Amiir of Qayrawaan [in what is now Tunisia], who sent an Arab fleet of 70 warships and 10,000 Moslem troops under the leadership of 'Asad Ibn Al-Foraat. The Moslem troops landed at the island and occupied Palermo and the western part of Sicily. . . . By 902 the Arabs had occupied the whole island of Sicily, which became a part of the Arab Empire. From Sicily the Arabs launched a campaign of conquest into the southern part of Italy and occupied Bari, Taranto, and other cities. . . . Their literature and culture flourished in Sicily which . . . produced a number of literary men, poets, historians. . . . The Arabic language was used by the administration for literary and commercial purposes until the middle of the 6th century of the Mohammedan era. . . . We are told that the Christian as well as the Moslem population lived in a peaceful atmosphere. . . . It was in Sicily that several books were translated from Arabic to Latin and from these knowledge was diffused into Europe. Such a book was the medical treatise of Imaam Al-Raazii. . . . This book has been the foundation of the study of medicine in Europe.

It was from southern Italy that the Normans conquered Sicily from the Arabs during the period from 1060 to 1090. As is plain from the quotation above, the Sicilian variety of Italian persisted throughout the Arabic occupancy, so that at that period there were spoken in Sicily three languages, each with great and growing dialecticality: Italian, Arabic, and Greek.

No one knows just when Arabic became extinct in Sicily, yielding to Italian, but Arabic land names, some of them coined in Arabic and some of them taken into Arabic from other or older languages, still obtain in Sicilian Italian.

The most notable geographical feature of the entire island of Sicily is Etna Mountain, the largest volcano of Europe, which rises about 10,000 feet high beside Sicily's eastern shore and is visible from the outlying

island of Malta. In Sicilian Italian this mountain is called Mongibello, which evidently consists of Mon-, mountain, plus the first part of the Arabic name of the mountain, which name is Djabal Ḥuṭaamaat, literally ash-residue mountain, the last word from the verb ḥuṭṭam, to shatter. This information is furnished by Dr. Habib Kurani. In ancient Greek, Etna Mountain was called Áitnee, from which descends Áitnee, pronounced Étni of the Greek dialect spoken in southernmost Italy, also standard Italian Etna, in the Abruzzi dialect clipped to Etn. For t instead of th in Áitnee compare ancient Greek aitría, clear sky, commonly aithría. With the entire word compare Old Irish aed, fire.

Greek is no longer spoken in Sicily, but Frederick II, Holy Roman Emperor (1194–1250), published a book of Sicilian laws in both Italian and Greek, which indicates that Sicilian Greek at that time obtained. At the present, Greek is spoken only in Calabria and in Terra d'Otranto, both situated in southernmost Italy. This Greek dialect has been thoroughly looked into by Italian scholars and is believed by them to come from the period of Byzantine rule. Rohlfs, however, thinks it comes from the time of the ancient Greek colonies of Sicily and that it shows only Byzantine dressing and influencing, basing his conclusions on the occurrence in the dialect of pre-Byzantine words.

PANTELLERIA

Pantelleria is the name of a small waterless island roughly midway between the western prong of Sicily and the northern coast of Africa, and also of the town additionally called Oppidulo at the northwest end of this island.

The ancient name of the island appears in Greek in three spellings: Kóssura, Kósura, and Kórsura. The Latin merely follows the Greek, calling the island Cosyra. This name may well have been taken from the indigenous language of the island, whatever that was. Phoenicians, who knew and colonized the island, perhaps called it by the same name; at least we do not know what they called it. A Phoenician etymology of the name Kóssura is therefore more or less absurd, since the name is not known to be Phoenician in origin.

Arabic took over the Latin-descended Romance name which it found in use for the island as Qawṣara(h), rarely spelled Qawṣara('), with q for Romance hard c, with aw anomalously for Romance o, with ṣ instead of s because of the q, and with a for y or i. Arabic already had a similar-sounding word, qawṣarra(h), a kind of basket woven of reeds for holding dates, but the soon-to-be-standardized name of the island was different from this in that it had r instead of rr. Professor Hitti located the mention of Qawṣara(') (spelled with final ' in the source!) in Yaaquut (Ibn Abdallaah Al-Ḥamawii), Ma'djam 'Al-Buldaan [geography, lit. compilation of countries], vol. 4, p. 200. This work was written at Mosul, 1228. The following translation is by Mr. Antar: "Others mention Qawṣara('), with final ', as an island in the Mediterranean between Mahdiis [which is apparently an Arabic name of what is now Tunisia or of some place therein] and Sicily. Ibn Al-Qaṭṭaa confirms Qawṣara(h) as an island in the sea which was conquered by the Moslems in the days of Ma'aawiya and remained in their occupation until the days of Ibn Marwaan. Then it was destroyed." Mr. Antar, who speaks Iraqan Arabic, knows well the Arabic word qawṣarra(h), a kind of basket made of reeds used for tamr, dates. The name Qawṣara(h) is still used of the island in Arabic, but became lost to Romance generations ago when the island was conquered by the Arabs.

Pantelleria was conquered back from Arabic-speaker possession into Romance-speaker possession by an expedition led by Roger of Sicily in 1123, and apparently from that, or from some subsequent time, but possibly from a time prior to the reconquest, the island emerges to speakers of Romance no longer as Cosyra, but as Pantelleria, a name that has found its way into Modern Greek, Arabic, Turkish, etc., but from Romance source, the name Cosyra being perpetuated to the present day by Arabic speakers of North Africa. That the name Cosyra must still have been in vogue for the island at the time of the Arabic Conquest is evidenced by the fact that con-

quering Arabs evidently learned the name of the island to be Cosyra and took over into their own language that name.

The present official or governmental Italian spelling of the name is Pantelleria, but there are also on record two other Italian forms: Pantalleria and Pantellaria. The unwritten accentuation is on the i. The initial p alone is sufficient to suggest that the word is Romance and not Arabic, since Arabic has no p and such a word as Peter is pronounced in Egyptian Arabic Buṭrus. The ll of the name need not worry us, for Italian is noted for interchanging l and ll freely in some words. For instance, one hears and writes lila, lilla, lilac. The name Pantelleria has a Romance and Greek-derived appearance, and we shall see below that it is doubtless an Italian and medieval Latin word derivatory to Greek.

After weeks of concentration on the etymology of Pantelleria, we would say that the etymology is by no means hopeless, and that even with our present documentation an extent of plausibility can be gained. The etymology is just difficult enough to make it entrancing.

Du Cange (Charles du Fresne), Glossarium Mediae et Infimae Latinitatis, still constitutes our principal thesaurus of Medieval Latin. Du Cange, one of France's greatest scholars, lived 1610 to 1688, and his Glossarium was first published at Frankfurt am Main 1669. The latest edition of this work, printed at Niort, France, in 1883, consists of ten great volumes, and a new and vastly enlarged edition remains yet to appear, but undoubtedly will appear in the future. The Du Cange Glossarium, vol. 6, p. 144, has an entry on "pantaleria," which is apparently the same word as the name of the island, in which this word is found to mean the same as panthera and to occur just once, this occurrence being in the Statutes of Mondoví (called Mons Regalis, royal mountain, in Medieval Latin), Piedmont. Although Du Cange unfortunately does not give the date of this occurrence, if indeed the date were known, but states only that the quotation is from folio 204. Mondoví was founded in 1198, so no occurrence could be prior to that date. The wording of the occurrence is: "subter pantalerias," beneath canopies. The word pantaleria is flatly stated by Du Cange to be derivatory to panthera, of which he has an entry on the following page as meaning: a canopy in which merchants expose their wares for sale, and gives for this shorter word another sole documentary occurrence in the Statutes of Asti, Piedmont, the date of occurrence lacking as in the instance of pantaleria. Du Cange indicates that the meaning of panthera as canopy is an extension of its meaning as duck-net, seabird-net, and that panthera in any meaning is the same as Medieval Latin pantera, panteria, both of which he gives under the entry pantera.

Turning to the much famed "Vocabolario" of Fanfani, the first edition of which came out in 1863, one finds that pantera, alias pantiera, continues to exist as an unusual word in modern Italian and has three meanings: (1) duck-net, evidently also seabird-net; (2) ditch or natural run where such a net is placed or could be placed; and (3) gay woman. Meanings 2 and 3 are unknown to even widely versed speakers of Italian but are on record in Fanfani. Greek dictionaries show pántheeros an adjective meaning catching all kinds of wild animals, and the neuter of this adjective, pántheeron, to be used as a noun meaning a net for all kinds of wild animals in contradistinction to a fish-net, the derivation being from pán, all, and theeráoo, to catch or hunt wild animal or animals. Compare Greek théera, a catching or hunting of wild animal or animals. Latin takes over pantheeron, a neuter noun, as panther, a masculine noun. Greek panthéera, a catching of all kinds of wild animals, is taken into Latin as pantheera, f, with the Greek meaning, and a purist would have to derive Medieval Latin pant(h)era from this rather than from Latin panther. The word has found its way not only into Italian, but into French, in which language pantière, f, means draw-net, shooting-pouch. The peculiar Medieval Latin meaning of display-canopy rests on an extension due to some resemblance that such a canopy bore to such a net.

As if the above were not already enough evidence for the ferreting out of the probable provenience of the name Pantelleria,

Avolio (Corrado), Saggio di Toponomastica Siciliana [Essay toward a Treatise on Sicilian Landnames], *in* Supplementi Periodici all' Archivio Glottologico Italiano, Torino, 1898, vol. 4, p. 98, announced his finding of a place name Pantiddaria situated near Mineo in the province of Catania, Sicily. With the apparent clusivizing of the ll to dd compare that shown in Gozzo, Ghawdax, Italian and Maltese Arabic names, respectively, of the island of Gozo, for which see below. Mineo is on maps and is situated about 50 miles northeast of the coastal city of Syracuse. Syracuse was called in Greek Surákousai, with preplacing of the definite article, and was spoken of in ancient times in Greek as the largest city of Sicily. Syracuse was in origin a colony founded from Corinth in 733 B.C., and we are expressly told that it was so called because there was a place nearby called Surakóo in the Sikelós language. Latin still keeps the Greek plural, having the form Syracusae. Italian Siracusa, the word having become singularized, is the name of the city and of a province. Mineo is a "comune," this Italian term being translated into English as borough. We have been unable to find any map that gives Pantiddaria, but Avolio is an authority of the highest reputation and calls attention to the resemblance of this name to the name of the island.

We accept Medieval Latin pantaleria as the same word as the name of the island. The undocumented point is how this word became applied as the name of the island. There are three possibilities: (1) that there was some spot where there was, or might be, a duck-net or seabird-net, and the existence of such a place would also account for the name Pantiddaria in Sicily; (2) that a display-canopy was, or perhaps was on occasion, erected on the island; (3) that there was a gay woman, or gay woman place, on the island. The two latter contingencies would perhaps presuppose the name to have been originally applied to the town. It is barely possible that thorough questioning of living informants at the island or at Pantiddaria, Sicily, may result in advancement of knowledge, or that further documentation may be found.

In addition to Qawṣara(h), which is the regular Arabic name of the island, Arabic also shows some use of Bantalariiya(h), with b for p because the Arabic alphabet has no p, and with an unusual degree of variation in spelling, rarely with ṭ for t and regularly with l for ll. Italian e of the second and third syllables becomes a in Arabic. Final (') instead of (h) also occurs.

LAMPEDUSA

Lampedusa is the principal one of the group of small islands situated midway between Malta and the coast of Africa, the official Italian name for which group being Isole Pelagie, this being based on an ancient Greek Nêesoi Pelágiai, lit. islands of the open sea, pélagos, though largely overlapping with thélassa in meaning, referring more to the open or high sea. One map calls this group in English the Pelage Islands. The Arabic rendition of the group name would be Djazaa'ir Al-Baḥr.

Greek Lupadôussa, Lampedusa, was taken into Latin as Lopadusa, with the usual rendering of Greek ss as s. Both Greek and Latin forms are possibly from an insular endemic name; and it will be noticed at once that both lack m, whereas Italian has Lampedusa. When we look around for some form toward which the name has become analogized, we have only to consider Lampione Island, 13 miles west of Lampedusa, which has the m, it being unnecessary to refer to other forms in amp in ancient and Modern Greek and in Latin and Italian.

The Arabic name of the island is Lambaduusa(h) or Lambaduusa('), from the Italian name, Italian e of the second syllable appearing in Arabic as a.

MALTA

Malta and its adjacent islands lie south of the southeastern corner of Sicily, as Pantelleria lies south of Sicily's western corner.

Greek Melítee, Malta, is possibly a name taken from the indigenous island language. Latin, with its rules of accentuation different from Greek, has Melita, from the Greek, but with antepenult accented, though Greek accents the penult. From the Latin form comes Old French melide, melite, utopia. From the Latin comes also Italian Malta, in

Abruzzi pronunciation shortened one step further to Malt.

Arabic Malṭa(h) is from Italian and is always with ṭ, whereas Maltese Arabic has Malta, this dialect or language doing away with all emphaticism of consonants. Dr. Kurani informs us that in Arabic Malṭa(') is a rare spelling and that he has also heard Maliṭi, the last as a sporadic direct borrowing from the modern Greek Melítee.

Malta is the principal island of what is called the Maltese Archipelago, but the island just north of Malta and nearly as large is almost as much mentioned. This northern island is Greek Gâulos, possibly of insular origin, and from the Greek is taken Latin Gaulus. From Latin form come Italian Gozzo and Maltese Arabic Għawdex, both of these showing the clusivizing of l, to which we have compared above that apparently contained in the name Pantiddaria. English has simplified the Italian form to Gozo.

The history of Malta is largely that of Sicily: early Greek and Phoenician colonization, followed by Roman conquest and introduction of what became the Sicilian dialect of Italian. In 395 Malta went with the Eastern Roman Empire. There were three Arabic invasions, but they have left little survival except the language. In Malta alone Arabic has survived, becoming extinct in Sicily, Pantelleria, and Lampedusa. The British acquired the Maltese Archipelago in 1800 after the French had held it for two years.

MALTESE ARABIC

As stated above, the only Arabic of the western Mediterranean islands is that of Malta and Gozo, and this is also the most curious dialect of Arabic that can anywhere be slated. It leans evidently on the extinct Sicilian and southernmost Italian mainland Arabic, for many words existing only in the Sicilian dialect of Italian, such as Sicilian Italian ciummu, lead (the metal), are telltale.

PHONETICS OF MALTESE ARABIC

That of the Maltese Archipelago is the only Arabic written with Latin letters, this romanization in Malta having antedated that of Rumania and Turkey by several centuries. Maltese Arabic is written using 29 letters, counting touched-up ones, and with Italian values. For instance, j has the sound of English y.

Vowels.—Maltese has the five vowels a, o, u, e, i, short and long, not merely short as in Italian. The most common diphthong is ie, pronounced as in Italian chiesa, church. Thus ktieb, book.

Consonants.—The most astonishing feature of the Maltese consonants, and of the phonetics of the language in general, is that there are no so-called emphatic consonants. In Hebrew three emphatics have merged into s, but in Maltese Arabic all emphatic consonants have become their nonemphatic correspondents. Hamzated alif occurs but is unwritten. The results of a terrible impact of Italian are found especially throughout the consonantism of Maltese. Some Maltese words are metathesized: artal, altar, for Italian altar. The letter x has the value of š.

MORPHOLOGY OF MALTESE ARABIC

ACTIONAL

Verb.—The verb is constructed like words of the other etymal classes out of triconsonantal groups, rarely out of quadriconsonantal or biconsonantal, or out of biconsonantal with one consonant defective, and may be simple or formed according to any one of eight derivative classes. The fourth class, active in other Arabic dialects, is vestigial only in Maltese Arabic, causative meaning having passed to the second class. There is no infinitive, but there is a deverbal noun.

Adverb.—As in the verb, one can distinguish primitive and derived adverbial formation. Adverbs can be practically grouped as answering the questions how, when, or where.

The preposition is a transitive adverb. Prepositions are classed as inseparable and separable.

Conjunction.—Conjunctions are sentence, phrase, and word connectives of adverbial or particle origin. One noticeable feature is that the Arabic wa-, and, written in ordinary Arabic as a prefix, is in Maltese written as a separate word: u, and.

Interjection.—The language is rich in

interjections. Sometimes an interjection is a contracted phrase; thus jommi, oh my!, for ja ommi, oh my mother! (ja, oh!; omm, f, mother).

SUBSTANTIVAL

Noun.—The Maltese noun has il- prefixed as a definite article, identical in form with the masculine definite article of Italian. Maltese is the only Arabic dialect which has il-; Egyptian and all the non-Maltese which leans on Egyptian Arabic has el-; the Classical and Middle East pronunciation is al-. That Italian influence partly accounts for the Maltese definite article having this form is perceived by the requirement in Maltese of, for instance, the idiom l-Italja, just as is the idiom in Italian itself, whereas extraneous Arabic merely says Iṭaalyaa('). The noun has masculine and feminine gender; six nouns of feminine form are masculine. There are two kinds of plural: (1) determinate, used for designating from 3 to 10 if the noun has no dual, from 2 to 10 if the noun has a dual; (2) indeterminate, denoting collectivity or material. Certain nouns can form a dual. According to formation, there are broken plurals and postfixal plurals. Some nouns have doublet plurals; for instance, durba, stroke, forms as its plural both draabi and draabijiet. Maltese has no case. Occasionally Arabicity crops out. It is a common trait of Arabic to refer to "the sons of Turkey" and the like, whereas other languages use such an expression only figuratively or poetically. Maltese not only has this Arabic usage, but man in general is bniedem, literally a son of Adam. The Maltese noun has five diminutive formations.

Adjective.—The adjective is handled on the whole like the noun but is a mere quality denoter. The adjective follows the noun, and in such an expression as "the door is large" one has to use two definite articles: In Maltese one says: il-bieb il-kbir, the-door (is) the-large, but in the entire extraneous Arabic speaking world one says: al-bab kabiir, the-door (is) large.

Pronoun.—Only the third person singular of the etymal personic has sexual gender distinction. The forms are:

jien(a), I	ahna, we
int(i), you	intom, ye
hu(wa), he	numa, they
hi(ja), she	

The possessive personopostfixes used with a noun are:

-i, -ja, my	-na, our
-ek, -ok, -k, your	-kom, yer
-u, -h, his	-hom, their
-ha, her	

The demonstrativals are:

daan, m, diin, f, this
daak, m, diik, f, that

Interrogativals are:

xi, what?
min, who?

The cardinal numerals from 1 to 10 are:

wiehed, 1	sitta, 6
tnejn, 2	sebgha, 7
tlieta, 3	tmienja, 8
erbgḥa, 4	disgḥa, 9
hamsa, 5	ghaxra, 10

SAMPLE TEXT OF MALTESE ARABIC

Missier-na, li inti fis-smewwiet, yitqaddes ism-ek, Our Father in heaven, hallowed be thy name.

missier, father, pls. missiriet, missirijet (Sicilian Italian misseri, also patri, father).

sema, sky, pl. smewwiet.

tqaddes, fifth class, to be sanctified.

isem, name.

This same passage in standard Sicilian Italian, the language which Maltese Arabic probably replaced in Malta, should be compared: Patri nostru, chi (also largely spelled ki) stai in celu, sia santificatu lu to nomu. (Contrast the standard Italian: Padre nostro chi sei ne' cieli, sia santificato il tuo nome; and the standard Arabic: Abaana(') al-laδii fis-samaawaat, liyataqaddas ismuk.)

SUMMARY

The aboriginal languages of the large islands of the western Mediterranean are extinct, and so is Phoenician. Arabic survives only on the Malta group. Otherwise these islands show only Romance, derived from Latin. The five island names Iviza, Corsica, Sardinia, Lampedusa, and Malta are possibly of native insular origin. The island names Majorca, Minorca, and Corsica are feminines of Latin adjectives in -ic-.

BOTANY.—*Three new species of* Alsophila *from Colombia and British Honduras.*[1] WILLIAM R. MAXON, U. S. National Museum.

The term "tree-fern," though occasionally applied to treelike members of Polypodiaceae, is tacitly restricted by botanists to the family Cyatheaceae, being in fact its vernacular equivalent. This usage, long in effect, is based on the treelike proportions of a great majority of the Cyatheaceae, which have strong upright woody trunks, commonly 5 to 10 meters high, surmounted by a crown of huge, finely dissected fronds. But just as the leaf blade ranges from quadripinnate to once-pinnate (even simply strap-shaped) in the hundreds of species constituting this group, so also there is every intermediate condition from massive towering fern-trunks to slender shorter ones, to others of moderate size that are weakly ascending or even prostrate (though bearing a crown of good-sized fronds), and still others with short decumbent rhizomes and small, simply pinnate fronds that are not larger than some of our common wood-ferns (*Dryopteris*), which in general appearance they considerably resemble.

Seven tropical American species of *Alsophila* with simply pinnate fronds and short, ascending or erect rhizome are currently recognized, all these being at hand. Three are added herewith. The assemblage is a heterogeneous one, and the species are for the most part not closely enough related to justify detailed comparison.

Alsophila haughtii Maxon, sp. nov.

Rhizoma erectum, usque ad 10 cm longum et 1.2 cm diam., deorsum copiose et crasse radicosum, apice paleaceum, paleis deltoideo-ovatis, acutiusculis, paulum supra basin affixis, 3–4 mm longis, 1.5–2 mm latis, medio brunnescentibus, striatis, lucidis, marginibus albidis. Folia 6–8, polysticha, usque ad 40 cm longa, patentia vel decurvata; stipites 10–12 cm longi, 1–2 mm diam., sordido-olivacei, inermes, inconspicue hirtelli (pilis septatis ochroleucis), paleacei, paleis numerosis, late oblongo-ovatis, acutiusculis vel obtusis, 4–6 mm longis, 2–3 mm latis, supra basin asymmetricam punctillo affixis, patentibus, sursum gradatim minoribus; laminae lineares vel lineari-oblongae, apice sensim acuminatae, basi paulum angustatae, usque ad 28 cm longae et 7 cm latae, 1-pinnatae, rhachi olivacea, hirtella, parcissime paleacea; pinnae ca. 16-jugae, patentes, anguste oblongae, pleraeque 2.5–3.5 cm longae et 10–13 mm latae, breviter petiolulatae, apice rotundatae, basi truncatae vel aequaliter subcordatae, vix auriculatae sed utrinque rotundatae, basin versus late crenatae, sursum remote et obscure vel leviter crenatae, apice ipso valde crenato-dentatae, textura membranaceo-herbaceae, supra glabrae, infra costis glabratis basin versus paleis albidis rotundatis parvis paucis primum praeditae; venae 10–12-jugae, liberae, tenues sed prominulae, 2–4-jugae basales pinnatim ramosae, venulis 3–6 parallelis, mediales pleraeque 1-furcatae, apicales simplices; sori inframediales, inter se subremoti, medio dorso venularum infimarum anteriorum posteriorumque vel (gregibus minoribus) solum anteriorum siti, parvi, receptaculo rotundo, sporangiis plerumque delapsis; paraphyses ut videtur paucae, parvae, cinereae, simplices.

Type in the U. S. National Herbarium, no. 1705805, collected on Cerro Armas, Department of Santander, Colombia, altitude 1,300 to 1,500 meters, on the face of sandstone cliffs, July 26, 1936, by Oscar Haught (no. 1957).

Except for *Alsophila kuhnii* (Hieron.) C. Chr., of Colombia, *A. haughtii* is by far the smallest member of the family Cyatheaceae known. It belongs apparently to that small group of tropical American species called *Trichopteris* by Presl, which includes *A. corcovadensis* (Raddi) C. Chr., *A. dichromatolepis* Fée, *A. elegans* Mart., *A. marginalis* Klotzsch, *A. sagittifolia* Hook., and *A. williamsii* Maxon, these agreeing essentially in type of soriation and, with the exception of *A. williamsii*, in having bipinnate blades and free veins. With *A. williamsii*,[2] which is wholly anomalous in its long-stalked simple pinnae, several-rowed sori, and large semi-octagonal costal areoles, it needs no comparison. The persistent broad, concave, pale scales of the stipe and rhizome recall those of *A. dichromatolepis*.

[1] Published by permission of the Secretary of the Smithsonian Institution. Received November 7, 1943.

[2] Contr. U. S. Nat. Herb. 24: 46. *pl. 17.* 1922.

Fig. 1.—*Alsophila parva* Maxon. One-half natural size.

Alsophila parva Maxon, sp. nov.

Rhizoma suberectum, ca. 15 cm longum et 1.5 cm diam., crasse radicosum, paleaceum, paleis adpresso-imbricatis, subdeltoideis, ca. 5 mm longis, 1.5–2 mm latis, longe acuminatis, aterrimis, crassis, opacis, subintegris. Folia ut videtur pauca, 70 cm longa; stipites 20 cm longi, 2–3.5 mm diam., olivaceo-brunnescentes, supra hirtelli et obtuse sulcati, subtus glabrati, basin versus decidue paleacei, paleis anguste triangularibus, longe acuminatis, 5–9 mm longis, 1.5–2.5 mm latis, falcatis, haud crassis, brunnescentibus, minute eroso-denticulatis; laminae exacte ovatae, apice abrupte acutae, basi angustatae, 50 cm longae, 25 cm latae, pinnato-pinnatifidae, rhachi epaleacea, glabrescente; pinnae infra apicem lobatum 7-jugae, alternae, remotae, patentes, oblongae, infra ad insertionem aerophoro maculaeformi instructae, infimae 7–8 cm longae, 3–4 cm latae, petiolulatae (5 mm); pinnae mediales subsessiles, 13–14 cm longae, 4–5 cm latae, apice abrupte acuminatae, basi subtruncata paulum angustatae, membranaceo-herbaceae, pinnatifidae, costa supra substrigosa, infra cum costulis et venis atque parenchymate pilis glanduliformibus unicellularibus hinc inde primum praedita; segmenta 10- vel 11-juga, late oblonga, paulum obliqua, 1–1.5 cm longa, 8–12 mm lata, apice oblique rotundata, contigua vel pleraque leviter imbricata, costae latere utroque ala 8–10 mm lata confluentia, sinubus vix apertis, costulis infra ad insertionem aerophoro maculaeformi instructis; venae 8–10-jugae, remotae, prominulae, basales pleraeque simplices, arcuatae, ad sinum egredientes, apicales simplices, alterae plerumque infra medium furcatae vel steriles bis (raro ter) furcatae; sori 3–4-jugi, mediales, magni, inter se 3–4 mm distantes, receptaculo globoso, paraphysibus perpaucis minutissimis instructo.

Type in the U. S. National Herbarium, no. 1140061, collected in forest near Córdoba, Department of El Valle, Colombia, altitude 80 to 100 meters, May 6–8, 1922, by Ellsworth P. Killip (no. 5254). Duplicates were distributed to the Gray Herbarium, the New York Botanical Garden, and the Academy of Natural Sciences of Philadelphia.

Although the present plant suggests in a general way the subgenus *Cnemidaria* of *Hemitelia*, it must nevertheless be referred to *Alsophila*, since the sorus is completely non-indusiate, lacking even the vestige of a minute inferior scale such as is noted in a few species of *Alsophila*. A suggestion of *Cnemidaria* is found also in a single instance of the junction of opposed basal veins by a transverse veinlet, and in other minor anomalies of venation. The presence of suborbicular black aerophores at the base of the costae and especially the costules throughout is a conspicuous character.

Alsophila ursina Maxon, sp. nov.

Rhizoma erectum, fortasse 10–15 cm longum (pars praestans 6 cm), ca. 2.5 cm diam., crasse radicosum, apice praecipue paleaceum, paleis numerosis, tenuibus, lanceolatis vel ovatis, longe acuminatis, 7–10 mm longis, 1.5–2.5 mm latis, brunneis, marginibus albidis integris abrupte scariosis exceptis. Folia pluria, cespitosa, ca. 1.25 m longa; stipites ca. 15 cm longi, 7–10 mm diam., brunnei, valde sulcati, ubique dense paleacei, paleis 1–1.5 cm longis, e basi lanceolata longissime attenuatis, brunneis, plerisque deflexis, numerosissimis et persistentibus; laminae lineares vel anguste oblanceolatae, ca. 110 cm longae, medio ca. 25 cm latae, apice acuminatae, basin versus gradatim angustatae, pinnato-pinnatifidae, rhachi stipiti simili, solum laminae apicem versus interrupte alata, ubique paleacea, paleis sursum gradatim minoribus; pinnae 35–40-jugae, fere horizontales, infimae oblongae, ca. 4 cm longae, apice rotundato-obtusae, petiolulatae (3 mm); pinnae mediales alternae, non contiguae, pleraeque sessiles, lineares, 11–13 cm longae, basi et medio 2.5–3 cm latae, apice acutae vel acutiusculae, pinnatifidae, herbaceae; costae supra substrigosae, subtus minute fibrillosae et paleis 2–4 mm longis lineari-attenuatis divaricatis rigidis brunneis intructae; segmenta ca. 16-juga, late oblonga, 8–10 mm longa, 5–6 mm. lata, apice oblique rotundata, falcata, subintegra vel undulata, late conjuncta, ala costae latere utroque 2–3 mm lata, supra glabra, subtus in venis primum minute fibrillosa, parenchymate glabro; venae ca. 8-jugae, sub angulo 45° egredientes, prominulae, acroscopicae pleraeque simplices, basiscopicae pleraeque paulum supra medium acutissime furcatae; sori 4–6-jugi, paulum supramediales, inter se remotae, mediocres, receptaculo globoso; sporangia numerosa, paraphyses teneras cinereas brevissimas maxime superantia.

Type in U. S. National Herbarium, nos 1791403–404, collected on Antelope Ridge, Stann Creek Valley, British Honduras, February 5, 1940, by Percy H. Gentle (no. 3197). It consists of a nearly complete frond (lacking only the extreme tip), attached to the apical portion of the caudex. Additional material of this collection is in the Herbarium of the University of Michigan and the National Herbarium.

Alsophila ursina is notable for the very dense persistent covering of long, spreading or retrorse, bright brown scales of its stipe and rachis. These give it a remarkable shaggy appearance, which has suggested the specific name.

ZOOLOGY.—*Rhizocephalan parasites of hermit crabs from the Northwest Pacific.*[1]

EDWARD G. REINHARD, Catholic University of America.

Only two rhizocephalan parasites of hermit crabs have previously been reported from the Northwest Pacific: *Peltogasterella socialis* Krüger from Puget Sound (Potts, 1915) and *Peltogaster* sp. from Nanaimo, British Columbia (Boschma, 1931). The material discussed in the present paper includes five genera and eight species, of which one genus and four species are new. This is not surprising in view of the limited attention the Rhizocephala have received in North America and the absence of any studies on these animals from Alaskan waters, where many specimens of the present collection were gathered years ago by the United States Fish Commission steamer *Albatross.*

A small but interesting lot of Rhizocephala from Puget Sound received from Dr. Roland Walker of Troy, N. Y., in 1940 provided the nucleus for the present study. This collection was especially noteworthy because on one species of crab, *Orthopagurus schmitti* (Stevens), there were three different rhizocephalans, two of which were new species. A personal search by the author of the general collection of Paguridae in the United States National Museum brought to light many additional parasitized hermit crabs, hitherto unstudied, and a few others were obtained from the Museum of History, Science and Art, Los Angeles, Calif.

Grateful acknowledgments are due Dr. Waldo L. Schmitt and his associate Clarence R. Shoemaker for many courtesies and ever-ready help extended the author during his visits to the division of marine invertebrates of the United States National Museum. To my former student, Sr. Mary Andrew Rauwolf, thanks are also extended for laboratory assistance in studying some of the Puget Sound material.

[1] Received December 20, 1943.

Family PELTOGASTERIDAE Lilljeborg
Genus **Peltogaster** Rathke
Peltogaster paguri Rathke

Material examined.—Coal Harbor, Unga Island, Alaska Peninsula, 8–9 fathoms, 1872, six specimens on six *Pagurus capillatus* (Benedict), W. H. Dall coll. U.S.N.M. 80471.

Unalaska, Aleutian Islands, tidal zone, July 10, 1937, two specimens on one *Pagurus hirsutiusculus* (Dana), V. B. Scheffer coll. U.S.N.M. 145827.

There is only one previous record of *Peltogaster paguri* from the Pacific Ocean, that of Krüger (1912), who mentioned this parasite as occurring on *Pagurus gracilipes* (Stimpson) from Japan. One specimen from each of the above hosts has been sectioned, and they exhibit no peculiarities when compared with specimens from the North Atlantic. This species probably parasitizes a number of other hermit crabs in the Alaska region. A peltogaster on *Pagurus trigonocheirus* (Stimpson) (U.S. N.M. 80472) and another on *Pagurus cornutus* (Benedict) (U.S.N.M. 80481), both from the Bering Sea, appear to be this species, but these specimens are too poorly preserved to permit certain identification and were not sectioned.

For anatomical details and literature on *Peltogaster paguri* see Boschma (1928, 1933); for life history and host-parasite relationship see Reinhard (1942, 1942a, 1942b).

Peltogaster boschmae, n. sp.

Fig. 3

Cotypes.—San Juan Archipelago, Wash., north shore of Stuart Island, 45 fathoms; off

False Bay, San Juan Island, 10–20 fathoms; south of Skipjack Island, 32 fathoms; August, 1940, three specimens on three *Orthopagurus schmitti* (Stevens), Roland Walker and Melville Hatch coll.

The host crabs in all three cases were females of about 4 mm carapace length and carried the parasite on the left side of the abdomen between the first and second pleopod. The specimens were oriented with their long axis parallel to the long axis of the host and with the mantle aperture directed forward. All three have been sectioned.

Diagnosis.—Body small, plump, curved. Stalk in the center of the dorsal surface, with elongated shield. Colleteric glands simple, at level of stalk. Male organs coextensive with shield; testes straight, bordered by distinct basement membrane, vasa deferentia coiled near their terminations. Ganglion overlapped by anterior ends of testes.

Description.—The dimensions of the largest specimen are: length 3.8 mm, breadth 1.5 mm, thickness 1.7 mm. Another specimen, slightly smaller, measures in length 3.3 mm, in breadth 1.5 mm and in thickness 1.5 mm. The third was damaged but its size must have been almost identical with the latter. Despite their small size, all three are mature animals with embryos present in the mantle cavity.

The slightly elevated mantle aperture lies at the anterior end of the animal but appears to be anterolateral because of the curvature of the sac. A prominent, slightly sinuous shield, resembling that found in *Peltogaster paguri*, attaches the central stalk to the dorsal surface of the animal. At its insertion into the body wall of the host the stalk lacks the projections of chitin which radiate from the holdfast of *P. paguri*.

The smooth external cuticle is 5μ to 9μ thick. Well developed muscles, including those of the sphincter, characterize the mantle, which is variable in thickness. It is thicker dorsally than ventrally and presents a number of low elevations on its inner surface. Although the nature of the retinacula was not ascertained, indications of their presence were occasionally seen on the internal cuticle examined in sections.

The mesentery is nearly as broad as the visceral mass and together they give a somewhat columnar appearance in transverse section. They extend the entire length of the sac. All the organs, except the ovaries, are confined to the midregion demarcated by the dorsal shield.

In "reading" the serial sections, the anterior ends of the testes are encountered before the ganglion comes into view. This organ in transverse section is shaped somewhat like an oxyoke and rests ventrally against the front tips of the testes. In *Peltogaster paguri* the ganglion is located anterior to the blind ends of the testes.

The male genital organs are comparatively thin-walled straight tubes and the hypertrophied region (honeycomb wall) is not so pronounced as in *P. paguri.* The outer surface of each testis is composed of a rather thick structureless membrane which is enveloped exteriorly by a thin layer of connective tissue cells. The presence of this membrane may be taken as a specific feature, since nothing like it occurs in the testes of *P. paguri.* At their posterior ends, the testes gradually pass into the vasa deferentia which are fairly long and become coiled near their terminations on the lateral surfaces of the visceral mass.

The colleteric glands begin in front of the stalk and end at the level of the stalk. They therefore occur in sections with the anterior portions of the testes. In one of the smaller specimens they are broadly crescentic in cross-sectional appearance but in the largest specimen they are more irregular. The epithelial wall of the gland is well developed.

There can be no doubt that this is the parasite studied and figured by Boschma (1931) under the name *Peltogaster* sp. in his account of the Rhizocephala of Dr. Th. Mortensen's Pacific Expedition, 1914–16. His material consisted of four specimens found on small unidentified pagurids collected at Nanaimo, British Columbia. The largest specimen had a length of 4 mm. As far as Boschma's description goes, it agrees in every detail with the animals described above. He noted the well-developed shield, the central stalk, the position and general characteristics of colleteric glands, testes, and vasa deferentia, but failed to observe the ganglion and the histology of the testes, the two main points, which, together with size, distinguish this species from *P. paguri.*

"Differences in size," remarks Boschma, "do not furnish sufficient evidence for regarding the

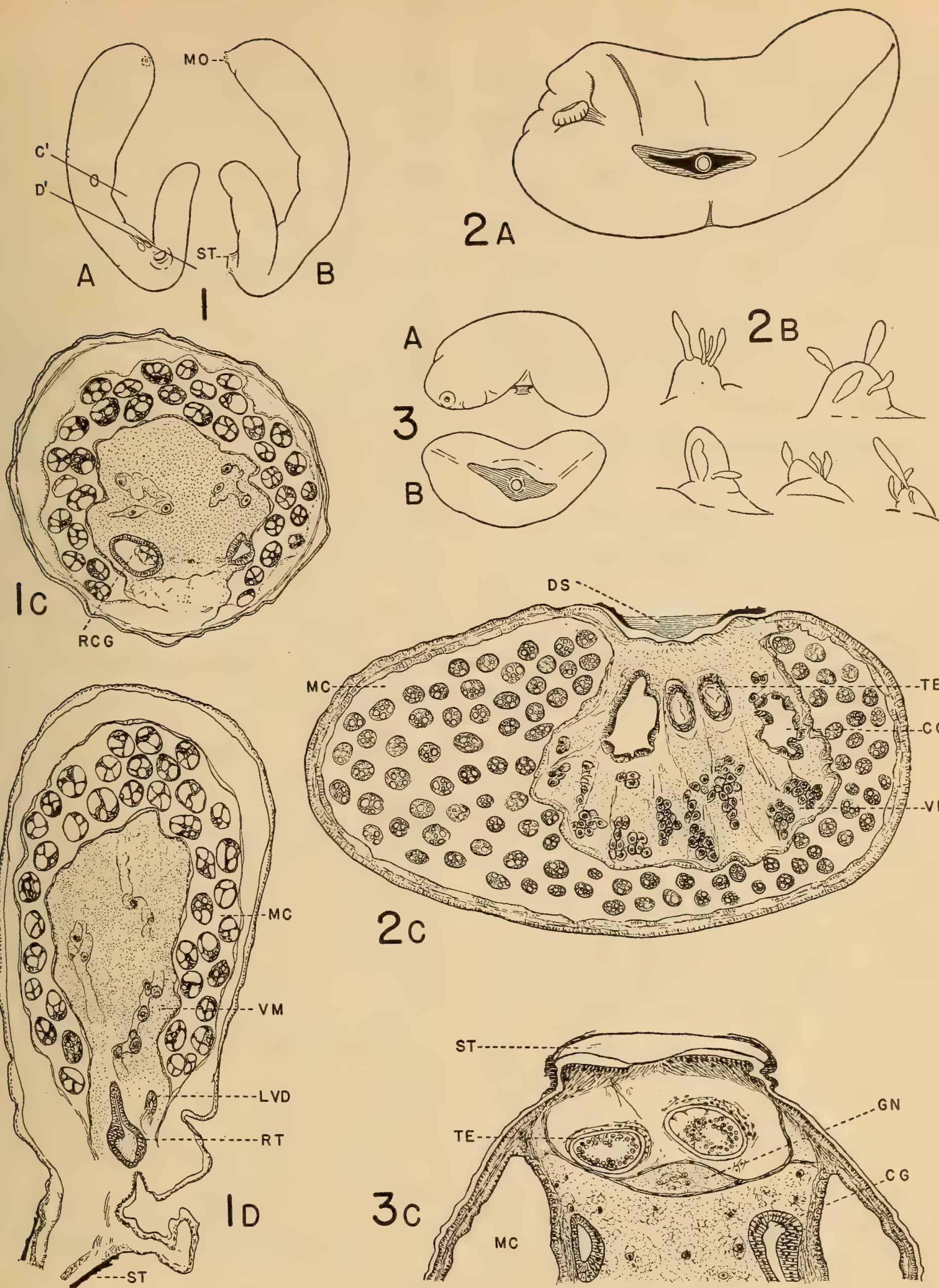

Fig. 1.—*Angulosaccus tenuis*, n. gen. and sp., from *Parapagurus armatus* Benedict, off Washington. *A*, Dorsal aspect of external sac viewed in tetralin, ×3. Lines *C'* and *D'* indicate planes of sections *C* and *D*, respectively. *B*, Right lateral aspect of same external sac, ×3. *C*, Transverse section through region of colleteric glands, ×25. *D*, Section passing through testes and stalk, ×25.

Fig. 2.—*Peltogaster depressus*, n. sp. *A*, From *Pagurus capillatus* (Benedict), Kodiak Island, Alaska, dorsal surface, ×5. *B*, Various retinacula from internal cuticle, ×300. *C*, Transverse section through anterior portion of dorsal shield, ×18.

Fig. 3.—*Peltogaster boschmae*, n. sp. *A*, From *Orthopagurus schmitti* (Stevens), San Juan Archipelago, Washington, lateral view, ×7. *B*, The same, dorsal surface, with anterior end directed towards the left, ×7. *C*, Portion of transverse section at anterior edge of stalk, ×67.

CG, colleteric gland; *DS*, dorsal shield; *GN*, ganglion; *LVD*, left vas deferens; *MC*, mantle cavity; *MO*, mantle opening; *RCG*, right colleteric gland; *RT*, right testis; *ST*, stalk; *VM*, visceral mass.

specimens from Nanaimo as representatives of a species which differs from *Peltogaster paguri*. But on the other hand I do not feel justified to identify them as *P. paguri*. For the present it is better to wait till more material from the locality has been examined."

The San Juan Archipelago, from which my specimens were obtained, is sufficiently close to the Nanaimo region to be considered the same general locality and accordingly I identify the Nanaimo specimens with the species described here and name the animal *P. boschmae* in honor of Dr. Boschma.

Peltogaster depressus, n. sp.

Fig. 2

Type.—Off Karluk, Kodiak Island, Alaska, 31 fathoms, July 19, 1897; one specimen on *Pagurus capillatus* (Benedict), *Albatross* coll. U.S.N.M. 80476.

Additional specimen.—Bering Sea, 57° 43′ 00″ N., 164° 42′ 00″ W., 31 fathoms, July 29, 1893; one specimen on *Pagurus capillatus* (Benedict), *Albatross* coll.

The hosts in both instances are males of 15–16 mm carapace length, and the parasites were attached to the abdomen, ventrolateral to the first pleopod, with their longitudinal axis parallel to that of the host. Both specimens have been sectioned, and the slides of the type are in the U. S. National Museum.

Diagnosis.—Sac flattened in dorsoventral direction, mantle opening on dorsal side near anterior margin, stalk central arising from fusiform dorsal shield. Testes straight, vasa deferentia coiled. Colleteric glands adjoining anterior portions of testes. Visceral mass fan-shaped in cross section. Retinacula consisting of two to five spindles on a prominent excrescence.

Description.—Compared with the other species of *Peltogaster*, this species is remarkably flat and broad. The type specimen has the following dimensions: 10.5 mm long, 5 mm wide, 3 mm thick. The measurements of the second are: 19 mm long, 10 mm wide, 5 mm thick.

The smaller parasite is practically straight, the larger one bent a little to the right. Both are flat dorsally and slightly arched ventrally. The mantle opening, at the anterior end, is peculiar in being shifted dorsally. It is a small aperture surrounded by a very low corrugated papilla. The stalk, approximately central in location, is comparatively narrow and arises from a fusiform dorsal shield. The insertion of the stalk in the body of the host is a heavily chitinized holdfast having branched marginal projections.

In both specimens the mantle cavity is spacious and contains numerous developing eggs. The visceral mass in cross section is rather fan-shaped, its mesenterial portion being much narrower than the broad distal portion which is flattened or slightly concave. It is well supplied with muscles: a circular layer at the periphery, and slender bundles at the interior, some of which run vertically, others transversely, and others diagonally.

In most other details of internal anatomy the animals resemble *Peltogaster paguri* very closely. The male genital organs and the colleteric glands are located under the dorsal shield, the glands being adjacent to the germinal or anterior portions of the testes. Coiled vasa deferentia pass backwards from the tubular testes as in *P. paguri* and end within the limits of the shield. The ganglion lies a short distance in front of the blind ends of the testes.

The retinacula that occur on the thin internal cuticle furnish further evidence that this is a distinct species. Each retinaculum (Fig. 2, B) is a rather tall and broad hillock, from the sides or summit of which arise two to five spindles, or rarely a single spindle. These have a more or less pointed extremity and a narrowed, stalklike basal part. They vary in thickness and length in the same cluster. Usually there is one large spindle 20μ to 24μ in length in each group along with others of lesser length. The smallest are 5μ to 6μ long. In *Peltogaster paguri* the spindles are fairly uniform in size, about 16μ long, are often single, and arise from the summit of a much less prominent excrescence.

Genus **Peltogasterella** Krüger

Because of the new species described below the diagnosis of this genus (Boschma 1933) is here amended:

Gregarious, external sacs elongate, more or less cylindrical. Mantle opening at the anterior extremity, stalk at or near the posterior extremity. Mesentery broad (as in *Peltogaster*). Testes enclosed in a common sac, dorsally

situated in the posterior third of the animal. Vasa deferentia short, opening backwards into the mantle cavity. Colleteric glands near middle of body at lateral surfaces of the visceral mass, consisting of simple flattened cavities. Nauplius larvae, on Paguridea.

Two species known.

Peltogasterella socialis Krüger

Fig. 5

Material examined.—Yaquina Light, Oregon-Washington coast, 34 fathoms, September 2, 1914; 7 specimens of 3–4 mm length on one *Pagurus alaskensis* (Benedict), *Albatross* coll. U.S.N.M. 80461.

Straits of Juan de Fuca, Wash., 53 fathoms, September 2, 1891; 10 specimens of 8 mm length on one *Pagurus aleuticus* (Benedict), *Albatross* coll. U.S.N.M. 80462.

Kasaan Bay, Prince of Wales Island, southeastern Alaska, 42–47 fathoms, July 1903; 3 specimens of 7–8 mm length on one *Pagurus aleuticus* (Benedict), *Albatross* coll. U.S.N.M. 80466.

Northwest of Unimak Island, Alaska, 41 fathoms, June 24, 1890; 52 specimens of 5–9 mm length on *Pagurus splendescens* Owen (40 on one host, 12 on another), *Albatross* coll. U.S.N.M. 80467.

Alaska, Bering Sea, 56° 12′ 30″ N., 162° 13′ 00″ W., 47 fathoms, June 28, 1890; 6 specimens of 3 mm length on one *Pagurus splendescens* Owen, *Albatross* coll. U.S.N.M. 80468.

In external form the specimens conform to the descriptions and drawings of previous authors (Krüger, 1912; Potts, 1915; Boschma, 1933; Hiro, 1935). Boschma is the only one who has given details of the internal anatomy, and to his description a number of new points are here added.

Diagnosis.—Body slender, cylindrical, concave dorsally; length at least three times the breadth; broadest near anterior pole. Stalk thin, feebly chitinized, arising dorsally from posterior pole. Testes in posterior third of body, enclosed in common sac; vasa deferentia short and straight, opening posteriorly. Colleteric glands simple, placed slightly posterior

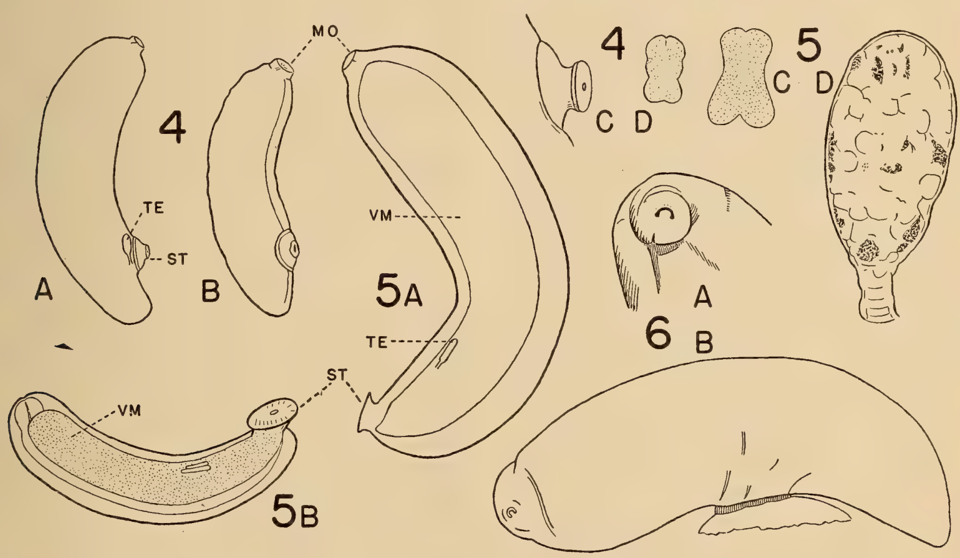

Fig. 4.—*Peltogasterella subterminalis*, n. sp. *A*, From *Pagurus hemphilli* (Benedict), San Miguel Island, Calif., lateral view of cleared specimen, ×8. *B*, From *Orthopagurus schmitti* (Stevens), San Juan Island, Wash., lateral view, ×8. *C*, Stalk of specimen from *P. hemphilli*, ×17. *D*, Eye of nauplius larva, ×400.

Fig. 5.—*Peltogasterella socialis* Krüger. *A*, From *Pagurus aleuticus* (Benedict), Straits of Juan de Fuca, Wash., lateral view of cleared specimen, ×8. *B*, From *Pagurus splendescens* Owen, Alaska; immature animal with undeveloped mantle opening (at left); dorsolateral view of cleared specimen, ×13. *C*, Eye of nauplius larva, ×400. *D*, Saccular type of testis; entire organ dissected from parasite, ×180. Note pigment spots in testis.

Fig. 6.—*Clistosaccus paguri* Lilljeborg. *A*, Mantle aperture and adjacent area, ×7. *B*, Specimen from *Pagurus capillatus* (Benedict), Bering Sea, lateral view, ×5.

MO, mantle opening; *S T*, stalk; *TE*, testis; *VM*, visceral mass.

to middle of body. Ganglion at extreme anterior end of visceral mass. External cuticle smooth, thin; internal cuticle without retinacula.

Description.—The specimens examined can be divided into two forms, those having tubular testes and those with saccular testes. The tubular type was found in the parasites on *P. alaskensis* and in those on *P. splendescens* from Alaska, Bering Sea. All other specimens had saccular testes (Fig. 5, D). Unfortunately, the parasites with tubular testes were all very young animals, so a possibility exists that this may be a juvenile feature.

However, the specimens that Boschma examined, also parasites of *P. alaskensis* from the same general locality as ours, were mature animals of 6 to 8 mm length, and these evidently possessed tubular testes since he states that the testes and vasa deferentia formed a more or less straight tube and that the testes gradually passed into the vasa deferentia.

It is relatively easy to see the gross appearance of the testes of *Peltogasterella*, previous to sectioning, by examining the animal in a clearing oil which renders it transparent. We used tetralin (tetrahydronaphthalene) for this purpose. Viewed in this way, the tubular testes of a 4-mm animal were found to measure 360μ in length and 108μ in width for the left testis and 328μ in length and 99μ in width for the right testis. Measurements of saccular testes from 6-to-7 mm animals gave lengths varying from 167μ to 184μ and an average width of 85μ. In the case of the saccular testes the vasa deferentia emerge quite abruptly.

Since in all other structural details these two forms of *Peltogasterella* seem identical, I do not think it necessary to separate them into different species, particularly since we cannot be sure which form of testes Krüger's type specimens possessed.

Regardless of whether the testes are tubular or saccular, they are always enclosed in a common sac, a feature that Boschma fails to mention but that evidently existed in his specimens as evidenced by his figure 6. This sac is filled with a mesenchymatous tissue in which the gonads are embedded. The testes proper are comparatively thin-walled with a distinct basement membrane. In the majority of cases they contain brownish pigment spots.

The vasa deferentia, which are included in the sac only at their point of origin, diverge to open on the lateral surfaces of the mesentery. They are relatively thin, short and uncoiled.

The colleteric glands, seen in cross sections as comparatively tall, narrow sacs with a simple unfolded lumen, extend in mature animals about 300μ in a dorsoventral direction along the lateral surfaces of the visceral mass in a locus slightly posterior to the center of the body. At the very beginning of the visceral mass, a small ganglion is located.

The mantle is uneven in thickness, varying from 20μ to 60μ in the same cross section. Its musculature is feebly developed. The external cuticle of mature specimens measures 5μ to 8μ in thickness. On the thinner internal cuticle no retinacula were found.

Since the visceral mass in a 6-mm specimen is solidly packed with large eggs, and early embryos are likewise present in the mantle cavity, it is likely that more than one brood of nauplii is produced. The much shrunken visceral mass, practically devoid of eggs, occurring in an 8-mm specimen which has practically mature nauplii in the mantle cavity is interpreted as a sign of old age. Fifteen nauplii from this specimen were measured. They varied in length from 207μ to 247μ with an average of 230μ. The pigmented eye of the nauplius is relatively large, 32μ to 36μ long, and has a characteristic shape (Fig. 5, C).

Peltogasterella subterminalis, n. sp.

Fig. 4

Cotypes.—Off San Juan Island, Wash., 20–30 fathoms, August 5, 1940; 10 specimens, of 4 to 5 mm length on two *Orthopagurus schmitti* (Stevens), Roland Walker and Melville Hatch coll.

Additional specimens.—Cuylers Harbor, San Miguel Island, Calif., July 1939; 35 specimens of 5 to 6.5 mm length on six *Pagurus hemphilli* (Benedict), Museum of History, Science and Art, Los Angeles, Calif. U.S.N.M. 80464.

Stephens Passage, Alaska, 198 fathoms, July 14, 1903; 4 specimens of 5 mm length on one *Pagurus aleuticus* (Benedict), *Albatross* coll. U.S.N.M. 80463.

Afognak Bay, Afognak Island, Alaska, 19 fathoms, August 3, 1903; 15 specimens of 3 to 5 mm length on one *Pagurus dalli* (Benedict), *Albatross* coll. U.S.N.M. 80459.

Alaska Peninsula, 54° 55′ 00″ N., 159° 52′

00″ W., 35 fathoms, August 4, 1888; 12 specimens of 3 mm length on one *Pagurus splendescens* Owen, *Albatross* coll. U.S.N.M. 80480.

The specimens on *Orthopagurus schmitti* from the Friday Harbor region (San Juan Island) have been selected as the cotypes. Four of these were sectioned and two macerated in an effort to discover retinacula. The remainder have been deposited in the collections of the United States National Museum. One specimen from each of the other hosts was likewise sectioned, and some others were examined either cleared or as stained whole mounts.

Diagnosis.—External form slender, cylindrical; mantle opening at anterior extremity, tilted dorsally; stalk near posterior extremity but not terminal, arising from a thin conical shield. External cuticle thin, smooth; internal cuticle without retinacula. Male genital glands saccular, pigmented, in front of stalk; vasa deferentia short, straight, opening posteriorly. Colleteric glands simple, in anterior half of body. Ganglion at anterior end of visceral mass.

Description.—These parasites differ externally from *P. socialis* in being smaller and more uniform in diameter with a stalk that arises from a slightly elevated conical shield near the posterior end but never terminal in position (hence the specific name *subterminalis*). Internally, the chief difference lies in the position of the colleteric glands which are farther forward than in *P. socialis.* Moreover, this species appears to average fewer specimens per host than is the case with its congener *socialis.*

The largest specimen encountered measured 6.5 mm in length. The average length of 21 adult individuals was 5.2 mm. Width and thickness are approximately equal, varying from 1.2 to 1.7 mm in adult specimens.

The mantle, which measures from 20μ to 50μ in thickness, has rather numerous lacunae and well-developed bands of circular muscle. Longitudinal muscle fibers are practically restricted to the ventral side of the animal where they interrupt the circular layer. The external cuticle is 4μ to 8μ thick.

The visceral mass appears rounded in cross sections of immature animals, but becomes laterally compressed when embryos are present in the mantle cavity. On the lateral edges of the visceral mass are to be found the paired colleteric glands, the left gland being slightly anterior to the right. Their position is a little less than half the distance from anterior to posterior ends of the animal. The dorsoventral height of these glands, measured at the highest portion, is 200μ to 225μ; the lateral width about 90μ to 140μ.

The testes lie in front of the stalk, often so close that the shield covers them. As is the case with the colleteric glands, the left testis begins a little anterior to the right, and is often larger. The testes have a length of 215μ to 250μ and a maximum width of 110μ to 130μ. As in *P. socialis* both are enclosed in a single sac and have a well-defined basement membrane. The vasa deferentia are likewise similar to those of *P. socialis.*

A ganglion is present at the anterior extremity of the visceral mass and a sheet of what may be nervous tissue is sometimes seen as a thin transverse band between the ovaries and male genital organs.

The nauplii of this species differ from those of *P. socialis* in their smaller size and in the size and shape of the pigmented eye (Fig. 4, D). Twelve measured specimens averaged 202μ in length (max. 216μ, min. 190μ) and 135μ in width (max. 148μ, min. 126μ). The eye measures 22μ to 27μ in length as compared with 32μ to 36μ for *socialis.*

There is a small gregarious European peltogastrid, *Gemmosaccus sulcatus*[2] (Lilljeborg), which presents some points of resemblance to this new species of *Peltogasterella.* In both, the stalk is posterior and the testes are saccular and pigmented. But in *Gemmosaccus* the stalk is located at a distance of about two-thirds from the anterior end, while here the distance is greater, being about five-sixths of the total length. Moreover, the finer points of the internal anatomy of *subterminalis* such as the conspicuous testicular sac, and the character of the nauplius larvae likewise, definitely place it in the genus *Peltogasterella.*

This general resemblance of our species to *Gemmosaccus sulcatus* suggests that Krüger's report of finding the latter species on the coast of Japan may be erroneous. Krüger's (1912) account is brief and unsatisfactory, and it may be that the parasites he called *Peltogaster sulcatus* were actually *Peltogasterella* of the species described here.

[2] This species also occurs in the literature under the names *Peltogaster sulcatus* or *Chlorogaster sulcatus.*

Angulosaccus, n. gen.

Diagnosis.—Gregarious, body elongate, posterior portion reflexed laterally. Mantle opening at anterior extremity, stalk dorsal at the angle between anterior and posterior arms. Mesentery and visceral mass broad. Ganglion near anterior end. Colleteric glands simple. Testes saccular, paired, situated in front of stalk, with vasa deferentia emerging anteriorly. On Paguridea.

Genotype.—*Angulosaccus tenuis*, n. sp.

In all respects, except one, *Angulosaccus* conforms to the structural characteristics of the Peltogasteridae. The forwardly directed vasa deferentia, however, constitute a unique feature, certainly of generic significance, although not important enough in my opinion to justify setting up a new family. Inclusion of this new genus in the Peltogasteridae, necessitates, however, a redefinition of the family, since in all known genera of Peltogasteridae, except *Angulosaccus*, the testes open backwards into the mantle cavity. For the latest diagnosis of the family see van Baal (1937).

Angulosaccus tenuis, n. sp.

Figs. 1; 7, A

Cotypes.—Off Washington, 47° 22′ 00″ N., 125° 48′ 30″ W., 877 fathoms, June 29, 1889; 12 specimens on one *Parapagurus armatus* Benedict, *Albatross* coll. U.S.N.M. 80479.

Of the 12 specimens attached to the abdomen of the host, two were made into stained whole mounts, two were cut into serial sections, and one damaged specimen was used to study the nature of the cuticula.

Diagnosis.—Body slender, broadest near anterior end, posterior third reflexed dextrolaterally. Testes immediately in front of stalk, with straight vasa deferentia opening anteriorly. Colleteric glands about midway between stalk and mantle opening. No retinacula.

Description.—In external form the sacs are long, slender, and cylindrical, and are sharply bent at the region of the stalk so that the animal is somewhat V-shaped, but with the prepeduncular arm considerably longer than the postpeduncular. The anterior arm is curved in a dorsosinistral direction, and at its forward extremity a small inconspicuous mantle opening is present.

Eleven of the specimens are almost identical in size, measuring about 10 mm in length for the anterior arm and from 3 to 4 mm in length for the posterior arm. From a maximum width of 3 mm near the mantle opening, the sac tapers to a width of 1.5 mm within the first half of its length and thereafter remains relatively uniform to the posterior extremity, which decreases slightly to 1 mm in width. One specimen was very small, having a total length of 5.3 mm of which 3.8 mm represented the anterior arm.

The external cuticle is smooth and about 5μ thick. The internal cuticle lacks retinacula. Because the soft tissues of the mantle had, to a large extent, disintegrated, as is to be expected in specimens preserved for more than half a century, nothing further could be learned about the nature of the mantle.

The mesentery and visceral mass are broad and extend the whole length of the sac. In the entire region in front of the colleteric glands the visceral mass, in both sectioned specimens, has a rather broad midventral notch. Since preservation occurred shortly after the animals had released eggs into the mantle cavity, the visceral mass contained only a pair of thin irregular egg cords, which could be traced to their connections with the colleteric glands.

A small ganglion is located in the mesentery a short distance behind the mantle opening.

The colleteric glands, found on the dorsolateral sides of the visceral mass a little more than halfway between the mantle opening and the stalk, have a simple undivided lumen. They measure 225μ to 300μ in a dorsoventral direction, 100μ to 135μ laterally, and 325μ to 450μ in anteroposterior direction.

The two saccular testes lie dorsally, just in front of the stalk. They are comparatively small, measuring 250μ to 265μ in length and 170μ to 180μ in width. The thin vasa deferentia are not coiled and run forward a distance of 300μ to 450μ, being therefore longer than the testes. Each vas is lined with chitin throughout its length.

The stalk is fairly broad and arises from a disk-shaped plate. Both are chitinized, but not heavily so, the chitin measuring 20μ to 30μ in thickness.

The curious shape of this species is reminiscent of that of *Gemmosaccus delagei* described by Duboscq (1912) from the coast of

France, except that the latter species is bent in a ventral direction.

Family Clistosaccidae Boschma

Genus **Clistosaccus** Lilljeborg

Clistosaccus paguri Lilljeborg

Figs. 6; 7, B

This is the only known species of the genus *Clistosaccus*. It has been found on the following hermit crabs: *Pagurus bernhardus*, *Anapagurus chiroacanthus* and *A. forbesi*, and *Pagurus pubescens*. All previous records are from the North Atlantic region. I am now able to report its occurrence in the North Pacific and add several new hosts.

This animal is also referred to in the literature as *Apeltes paguri* Lilljeborg, but Boschma (1928) has shown that the two alleged species are different stages of one species only, *Clistosaccus* being the younger form, *Apeltes* the older mature form.

Material examined.—Bering Sea, 54° 48′ 00″ N., 165° 13′ 30″ W., 70 fathoms, June 24, 1890; five specimens on five *Pagurus capillatus* (Benedict), *Albatross* coll. U.S.N.M. 80474.

South of Alaska Peninsula, 54° 20′ 30″ N., 163° 37′ 00″ W., 61 fathoms, May 21, 1890, one specimen on one *Pagurus capillatus* (Benedict), *Albatross* coll. U.S.N.M. 80460.

South of Alaska Peninsula, 54° 05′ 30″ N., 162° 54′ 00″ W., 49 fathoms, May 21, 1890; three specimens on two *Pagurus dalli* (Benedict), *Albatross* coll. U.S.N.M. 80475.

Kodiak Island, Alaska, off Karluk Head, 122 fathoms, July 19, 1897; three specimens on one *Pagurus splendescens* Owen, *Albatross* coll. U.S.N.M. 80473.

The 12 specimens varied from 7 to 25 mm in length. The mantle opening when present has the appearance of an arched cleft on the summit of a short, smooth elevation. The arms of the opening enclose a pluglike extension of the visceral mass which projects to the exterior. Lilljeborg (1861) described the mantle opening of *Apeltes* (= *Clistosaccus*) as having an inferior border in the form of an obtuse point. If "dorsal" is substituted for "inferior" this description is essentially correct. All but two of the specimens had this type of opening; one, the smallest of 7 mm length, lacked a mantle opening; the other, of 10 mm length, had the beginning of a mantle opening, which had not yet perforated.

Boschma (1928) remarks that older specimens of *Clistosaccus* can not usually be distinguished from *Peltogaster paguri* without recourse to microscopic sections. There are, however, good external diagnostic features. The stalk of attachment in *Clistosaccus* is broad, in *P. paguri* it is much narrower; *Clistosaccus* completely lacks the thick chitinous dorsal shield (hence "*Apeltes*") which in *P. paguri* extends prominently anteriorly and posteriorly from the stalk and is the feature that suggested the name *Peltogaster*.[3] Moreover, at no stage in

[3] Rathke, who gave the name to the genus, was mistaken in considering the shield-bearing surface as the "gaster" or ventral side of the animal.

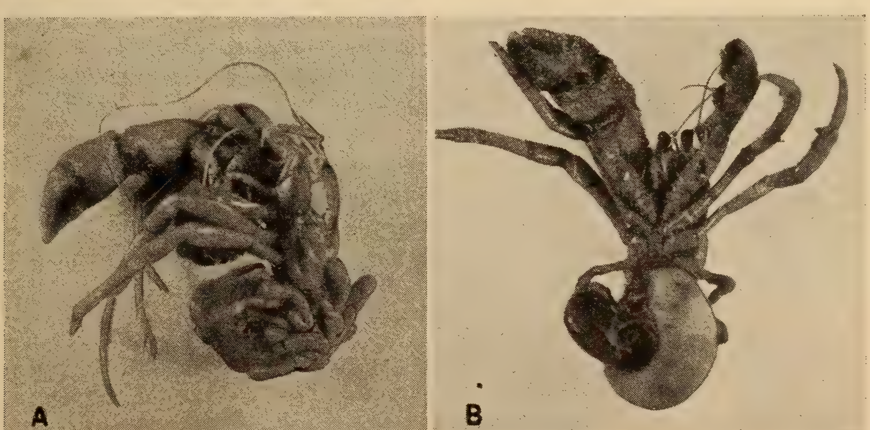

Fig. 7.—*A*, *Angulosaccus tenuis* n. gen. and sp., on *Parapagurus armatus* Benedict, Washington. *B*, *Clistosaccus paguri* Lilljeborg on *Pagurus capillatus* (Benedict), Alaska. Both natural size.

development does *Peltogaster* have a mantle opening like that described above for *Clistosaccus.*

Two specimens were sectioned and compared with material from the North Atlantic, but no essential difference could be detected between east and west coast animals. The single sac-like testis in the anterior region with its two short vasa deferentia and the lobulated colleteric gland at the posterior end of the visceral mass are as described by Boschma. Likewise, his statement that the internal cuticle lacks retinacula can be confirmed.

It may be mentioned that the visceral mass in normal specimens reaches only to the posterior margin of the stalk, which is located in the posterior half of the body, at variable relative distances from the middle. There is thus a fairly extensive post-peduncular region often present where internal organs are lacking.

Family Uncertain

Genus **Thompsonia** Kossmann

Thompsonia sp.

Material examined.—San Juan Archipelago, Wash., off False Bay, San Juan Island, 10–20 fathoms, Aug. 5, 1940; seven specimens on one *Orthopagurus schmitti* (Stevens), Roland Walker and Melville Hatch coll.

These parasites are small ovoid or pear-shaped sacs attached to the dorsal surface of the anterior abdominal segments of the host. The stalk of attachment is very short and has a proximal constriction. Stumps or scars of about 20 stalks are present on the abdomen in addition to the 7 stalked sacs still remaining. These sacs were mature since they contain cypris larvae.

The body of the parasite, exclusive of the stalk, measures 1.2 to 1.5 mm in length and 0.8 to 1.0 mm in thickness. The stalk is one-sixth or less the length of the body. The cypris larvae appear to lack pigmented eyes.

Boschma (1933) is of the opinion that in the present state of our knowledge it is impossible to decide which of the named forms of *Thompsonia* are distinct species. In accordance with this view I believe it best not to give a specific name to these specimens on *Orthopagurus.* The host, however, constitutes a new record for this genus. The parasites have been deposited in the collections of the United States National Museum.

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ZOOLOGY.—*Nemerteans from the northwest coast of Greenland and other Arctic seas.*[1] WESLEY R. COE, Scripps Institution of Oceanography. (Communicated by WALDO L. SCHMITT.)

A small collection containing 12 specimens of nemerteans was obtained in July, 1940, by Capt. Robert A. Bartlett at depths of 23 to 115 meters off the northwest coast of Greenland. The four species represented are of interest because none of them had been reported previously from that locality. All, however, had been collected formerly from other portions of the coast of Greenland and elsewhere in the Arctic. In this paper the distribution of each of these species as known at the present time is indicated, and a supplementary account is given of such organ systems as had heretofore been inadequately described. A list of the 30 other species that have been found in the Arctic is appended, with the geographical distribution of each.

Tubulanus annulatus (Montagu)

Gordius annulatus Montagu, 1804.
Carinella annulata Bürger, 1895, 1903.

One incomplete individual was dredged at a depth of 50 to 115 meters 1 mile northwest of Conical Rock. This specimen is 3 to 4 mm in width, indicating an individual having a total length of 20 to 30 cm when living.

This species is widely distributed on the eastern shores of the North Atlantic, from Norway and Great Britain to the Mediterranean; it has also been found in the South Atlantic, near the Cape of Good Hope (Stimpson, 1856). It is closely similar to *T. nothus* Bürger, which has likewise been found near the Cape of Good Hope (Wheeler, 1934). In the Arctic it was previously dredged near King Karl Land; also off Cape Platen and in the Karajek Fiord, Greenland. Only a few other species of nemerteans are known to have such an extensive geographical distribution.

Micrura purpurea (Dalyell)

Gordius purpureus spinifer Dalyell, 1853.
Micrura purpurea Joh. Müller, 1858; Bürger, 1903.

[1] Contribution of the Scripps Institution of Oceanography, University of California, new ser., no. 217. Received October 27, 1943.

Four large individuals evidently belonging to this species were dredged at depths of 45 to 115 meters 1 mile northwest of Conical Rock, northwest Greenland. The specimens after preservation measured 60 to 90 mm in length and 4 to 5 mm in width, indicating a length in life of 150 mm or more. As is the case with many other invertebrates, these worms frequently reach a larger size in the Arctic than in warmer regions. Individuals from the coast of Scotland average considerably larger than those of the same species in the Mediterranean and if the specimens in this collection are correctly identified, those of the Arctic regions become even larger. The same condition holds for *Tubulanus annulatus.*

This species is common on the European coasts from Scotland to the Mediterranean. It occurs from the intertidal zone to a depth of 200 meters or more. In the Arctic it was previously reported from Karajak Fiord, Greenland; also from Hinlopen Strait at a depth of 80 meters.

Cerebratulus barentsi Bürger, 1895

One incomplete specimen measuring 11 mm in width was dredged at a depth of 24 meters off the north shore of Wolsterholm Sound, northwest Greenland. The deep reddish brown pigmentation of the body was still retained after preservation for three years.

This species is known only from Arctic seas, having been reported from Kara Strait, from the sea north of Spitsbergen, Hinlopen Strait, Karajak Fiord, Greenland, off Amsterdam Island, and elsewhere at depths of 40 to 1000 meters.

Amphiporus groenlandicus Oersted, 1844

The collection contained six specimens of this common Arctic species. These measured 60 to 80 mm in length and 4 to 6 mm in width. They were dredged off the north shore of Wolsterholm Sound, northwest Greenland at a depth of about 20 meters.

These specimens were without ocelli and agreed in all essential respects with the published descriptions of this well-known species.

Serial sections of one individual showed that the internal anatomy conforms with that of other individuals described by Bürger (1895, 1903) from other portions of the Arctic seas.

Since Bürger's account contained no description of the armature of the proboscis nor of the reproductive organs, such descriptions may be included here. The stylet basis is rather slender, conical or elongated pear-shaped and about twice as long as the basal diameter. In these specimens the bases measure from 0.08 to 0.10 mm in length and 0.035 to 0.05 mm in diameter at the base.

The central stylet is nearly equal to the basis in length. With one exception the proboscis was provided with 2 pouches, each containing 3 to 5 accessory stylets. In one of the six specimens one of the pouches was divided into two parts. The number of proboscidial nerves varies from 16 to 18.

The cerebral sense organs are large and situated immediately anterior to the brain, with posterior extensions on the ventral sides of the dorsal ganglia. Large nerves unite them with the dorsal ganglia and from each of them a slender canal extends forward to open ventrolaterally in an oblique groove near the tip of the head.

The nephridia extend forward as far as the lateral borders of the brain. Near the posterior end of the nephridial system a large efferent duct opens ventrolaterally on each side of the body. The intestinal caecum extends forward nearly to the brain and sends lateral branches as far as the dorsal sides of the dorsal ganglia.

The gonads are much more numerous than the intestinal diverticula, as many as four or even six ovaries or spermaries being cut in a single transverse section of the body. They are situated both dorsally and ventrally to the lateral nerve cords, but the genital ducts with few exceptions open dorsolaterally.

Each of the six specimens was infested by protozoan parasites. These were most abundant within the blood vessels but others were imbedded in the adjacent connective tissue parenchyma.

This species is widely distributed in Arctic seas, having been reported from both the eastern and western coasts of Greenland, from Hinlopen Strait, Barents Sea, and from the waters off King Karl Land, Jena Island, Franz Joseph Land, and Spitsbergen at depths of 4 to 450 meters. A similar species, *A. caecus* Verrill, was dredged at a depth of about 35 meters off the New England coast north of Block Island, Mass. Coe (1943) suggested the possibility that the two supposed species may later prove to be specifically identical.

Other species previously reported from the Arctic seas include the following:

Tubulanus groenlandicus (Bergendal). North Greenland.

Lineus koalensis Uschakow. Barents Sea.

Lineus maris-albi Uschakow. White Sea.

Lineus ruber (O. F. Müller). Circumpolar; coasts of Siberia; Greenland; Norway and Great Britain to Mediterranean; Madeira and South Africa, Labrador to southern New England; Alaska to California.

Lineus saint-hilairi Uschakow. White Sea.

Micrura impressa (Stimpson). Bering Strait.

Micrura lithothamnii Uschakow. Kola Fiord.

Cerebratulus brevis Uschakow. White Sea.

Cerebratulus fuscus (McIntosh). Off the coasts of Greenland and elsewhere in Arctic seas; Great Britain and Norway to Mediterranean.

Cerebratulus greenlandicus Punnett. Greenland and North Greenland.

Cerebratulus marginatus Renier (= *C. fuscus* Verrill). From off King Karl Land, Bremer Sound, Hinlopen Strait, Amsterdam Island, and East Spitsbergen. This species has a wide circumpolar distribution, being found on European coasts as far south as Madeira; on the eastern North American coast southward to Cape Cod and farther south in the offshore current; on the western North American coast southward to southern California and in the western Pacific as far south as Japan.

Cerebratulus melanops Coe and Kunkel. Gulf of St. Lawrence and northward.

Cerebratulus rigidus Isler. Novaya Zemlya.

Cerebratulus zachsi Uschakow. White Sea and Kara Strait.

Emplectonema derjugini Uschakow. Kola Fiord, Barents Sea.

Emplectonema neesi (Oersted). Coasts of Greenland, Iceland, Norway and Great Britain to Mediterranean.

Nemertopsis actinophila Bürger. Coasts of Bären Island; Ross Island; King Karl Land; Lomme Bay; Hinlopen Strait; from low-water mark to 240 meters.

Amphiporus angulatus (Fabricius). This com-

mon and widely distributed Arctic species appears to have been described also by Verrill as *A. stimpsoni*, *A. heterosorus*, *A. multisorus*, and *A. superbus;* also by Punnett as *A. thompsoni* and in part as *A. arcticus*. Greenland, Baffin Bay, Davis Strait, Labrador, Nova Scotia, and southward to Cape Cod on or near the coast and farther south beneath the offshore Arctic current. On the west coast of North America the species extends from the Arctic Ocean through Bering Sea, along the coast of Alaska and southward to Point Conception, California. On the Asiatic coast it occurs from Kamchatka to Japan.

Amphiporus hastatus McIntosh. Coasts of southern Greenland and northern Europe.

Amphiporus lactifloreus Johnston. Shores of Arctic and North Atlantic Oceans, extending southward to the Mediterranean Sea and on the American coast to Cape Cod; intertidal zone to 200 meters.

Amphiporus littoralis (Uschakow), *Gurjanovella littoralis* Uschakow. Barents Sea, White Sea.

Amphiporus macracanthus Coe. Arctic coast of Alaska.

Amphiporus murmanicum Uschakow. Kola Fiord.

Amphiporus pulcher (Johnston). Coasts of Spitsbergen, Norway, and Great Britain to Mediterranean; Greenland to Massachusetts Bay. Some of the specimens described by Punnett as *A. arcticus* evidently belonged to this species.

Tetrastemma albicollis Uschakow. Kola Fiord.

Tetrastemma arctica Uschakow. White Sea, Novaya Zemlya.

Tetrastemma candidum Müller. Circumpolar; Greenland to Madeira; South Africa; Alaska to Mexico.

Tetrastemma laminariae Uschakow. Kola Fiord; Novaya Zemlya.

Uniporus borealis (Punnett). Davis Strait.

Drepanophorus crassus Quatrefages. Widely distributed in Arctic, Antarctic and Tropics; dredged at a depth of 250 meters near Franz Joseph Land; coasts of Europe, Madeira, Mauritius, Kerguelen, Samoa, Tonga, Panama, West Indies.

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PROCEEDINGS OF THE ACADEMY AND AFFILIATED SOCIETIES

CHEMICAL SOCIETY

549TH MEETING

The 549th meeting (59th annual meeting) was held at the Cosmos Club on January 14, 1943. The reports of officers for 1942 were read and accepted. The membership of committees for 1943 was announced. Dr. P. HONIG, commissioner of the Board for the Netherlands-Indies, Surinam, and Curaçao, spoke on *Agriculture and nutrition in the Netherlands Indies.*

550TH MEETING

The 550th meeting was held at the Cosmos Club on February 11, 1943. Dr. C. B. PURVES, of the Massachusetts Institute of Technology, spoke on *The distribution of unsubstituted hydroxyl groups in some technical cellulose acetates and ethers.*

551ST MEETING

The 551st meeting and the annual dinner of the Society were held at the Y.W.C.A. on March 11, 1943. The Hillebrand Prize for 1942

was awarded to J. F. Schairer, of the Geophysical Laboratory, Carnegie Institution of Washington, in recognition of his work on phase relations in silicate systems. Dr. N. L. Bowen, of the University of Chicago, spoke on *High temperature chemistry of the silicates.*

552d Meeting

The 552d meeting was held at the Cosmos Club on April 8, 1943. Dr. R. W. Cairns, director of the Experiment Station, Hercules Powder Co., addressed the Society on *The properties of explosives.*

553d Meeting

The 553d meeting was held jointly with the Washington Academy of Sciences in the auditorium of National Museum on April 22, 1943. Dr. Linus Pauling, of the California Institute of Technology, spoke on *Chemical studies of the structure of antibodies.*

554th meeting

The 554th meeting was held at the Catholic University of America on May 13, 1943. At the conclusion of a general meeting, the following divisional meetings were held:

Biochemistry, J. P. Greenstein, presiding

The effect of dietary deficiency of certain B vitamins on the growth of tumors. Harold P. Morris (National Cancer Institute).

New tests in the guanidine field. M. X. Sullivan (Georgetown University).

A histochemical analysis of thyroid colloid. I. Gersh (U. S. Naval Hospital).

Organic Chemistry, Howard S. Mason, presiding

The preparation of diazomethane. F. O. Rice, Ralph Roberts, and H. P. Ward (Catholic University).

A survey of some researches on ketones and diketones. R. P. Barnes (Howard University).

Explanation of some reactions in the carbohydrate field by application of the concept of successive electron displacement. H. S. Isbell (National Bureau of Standards).

Inorganic and Analytical Chemistry,
H. P. Ward, presiding

The electron microscope in ceramics. H. F. McMurdie (National Bureau of Standards).

Separation of small amounts of chromium from vanadium with ethyl acetate. Margaret D. Foster (U. S. Geological Survey).

Determination of glass in Portland cement. Armin W. Helz (National Bureau of Standards).

Physical Chemistry, Darrell V. Sickman,
presiding

The effect of hydrogen-ion concentration on overvoltage. G. E. Kimball (Columbia University).

Calculation of vapor pressure. F. R. Bichowsky (Catholic University).

Investigation of the structure of the wool fiber by the electron microscope. Charles W. Hock and H. F. McMurdie (Textile Foundation and National Bureau of Standards).

555th meeting

The 555th meeting was held at the Cosmos Club on October 14, 1943. Dr. H. Mark, of the Polytechnic Institute of Brooklyn, spoke on *The elasticity of high polymers.*

556th meeting

The 556th meeting was held at the Cosmos Club on November 11, 1943. Dr. H. A. Bruson, Resinous Products and Chemical Co., spoke on *Newer developments in phenolic-formaldehyde resins.* The election of officers for 1944 was held with the following results: President, E. R. Smith; Secretary, M. M. Haring; Treasurer, L. A. Shinn; Councilors, F. G. Brickwedde, N. L. Drake, H. L. Haller, R. M. Hann, S. B. Hendricks, J. H. Hibben, B. H. Nicolet, I. C. Schoonover, J. R. Spies, M. X. Sullivan, E. Wichers; Managers, J. J. Fahey, R. Gilchrist, W. L. Hall, A. T. McPherson, C. E. White, J. K. Wolfe.

557th meeting

The 557th meeting was held at the George Washington University on November 24, 1943. After a general meeting, the following group meetings were held:

Biochemistry, M. X. Sullivan, presiding

Chemistry of the castor bean allergen. Joseph R. Spies and E. J. Coulson (Allergen Investigation, Agricultural Research Administration)

The successful treatment of blood dyscrasias by a new member of the vitamin B complex.

The reduction of 2,4,6-trinitrotoluene by tissues in vitro. Benton B. Westfall (National Institute of Health).

Organic Chemistry, W. WARD PIGMAN, presiding

Precise macroanalysis of carbon and hydrogen by combustion. D. D. WAGMAN and F. D. ROSSINI (National Bureau of Standards).

A study of the in vivo conversion of methionine to cystine by means of the carbon and sulphur isotopes. G. KILMER (University of Maryland).

Choice of reagents in the Diels-Alder synthesis of compounds with angle groups. L. W. BUTZ, M. ORCHIN, W. NUDENBERG, B. M. GADDIS, and E. W. J. BUTZ (Bureau of Animal Industry).

A probable relationship between turanose and maltose. C. S. HUDSON (National Institute of Health).

Acetolysis of trimethylene-d-mannitol; 2,5-Methylene-d-Mannitol. A. T. NESS, R. M. HANN, and C. S. HUDSON (National Institute of Health).

Physical Chemistry, F. D. ROSSINI, presiding

Significance of internal structure in gelatinizing silicate minerals. K. J. MURATA (U. S. Geological Survey).

Standards for pH determinations. ROGER G. BATES (National Bureau of Standards).

Time-temperature freezing and melting curves. AUGUSTUS R. GLASGOW, Jr., WILLIAM J. TAYLOR, and FREDERICK D. ROSSINI (National Bureau of Standards).

Inorganic and Analytical Chemistry, RALEIGH GILCHRIST, presiding

Determination of boron in steel and iron by the distillation-titration (Chapin) method. JOHN L. HAGUE (National Bureau of Standards).

Determination of beryllium in ores. ROLLIN E. STEVENS and MAXWELL K. CARRON (U. S. Geological Survey).

Analytical separations by means of controlled hydrolytic precipitation. RALEIGH GILCHRIST (National Bureau of Standards).

558TH MEETING

The 558th meeting was held in the auditorium of the National Museum on December 9, 1943. Dr. R. D. COGHILL, of the Northern Regional Research Laboratory, spoke on *Fermentation as a tool in the industrial utilization of farm products.* Dr. C. A. BROWNE, of the Bureau of Agricultural and Industrial Chemistry, addressed the Society in commemoration of the 50th anniversary of its affiliation with the American Chemical Society.

EDGAR REYNOLDS SMITH, *Secretary*

Obituaries

ALEŠ HRDLIČKA, founder of physical anthropology in America, former president of this ACADEMY, and one of the world's foremost anthropologists, died in Washington on September 5, 1943. Born at Humpolec, Bohemia, March 29, 1869, he came to the United States at the age of 13. In 1892 he graduated from the Eclectic Medical College, New York City, and in 1894 from the New York Homeopathic Medical College. In 1894 he became research interne at the State Hospital for the Insane, Middletown, N. Y., and in 1896 was appointed associate in anthropology at the Pathological Institute of the New York State Hospitals.

Hrdlička's studies of the American Indian began in 1898 with an expedition to Mexico. From 1899 to 1902 he made trips to the Southwest and Mexico for the American Museum of Natural History.

In 1903 Dr. Hrdlička came to the National Museum as an assistant curator to establish a Division of Physical Anthropology. In 1910 he became curator of the division, a position retained until 1941 when he retired to continue his research as associate in anthropology. To enumerate the accomplishments of Dr. Hrdlička's long and fruitful career and to record the profound influence he exerted on physical anthropology would require far more space than is available here. He published more than 350 books and articles. He was a member of the National Academy of Sciences, the American Philosophical Society, the American Academy of Arts and Sciences, and numerous other American and foreign societies. He received the honorary degree of D. Nat. Sc. from Brünn University in 1926 and Sc.D. from Charles University, Prague, in 1929.

Dr. Hrdlička's anthropological studies took him to many parts of the world. The thousands of skulls and skeletons he brought back to the National Museum form the nucleus of one of

the world's greatest collections of human skeletal material. His six *Catalogs of human crania in the United States National Museum collections*, presenting measurements on about 7,000 non-White crania, constitute one of the most valuable sources of basic anthropometric data in existence. The seventh catalog, now in press, records measurements on 600 skulls excavated on Kodiak and the Aleutian Islands and comparable data on prehistoric and modern Siberian crania measured on his last trip to Russia in 1939. This is but one of the notable results accruing from Dr. Hrdlička's ten expeditions to Alaska between 1926 and 1938.

His volume, *The old Americans*, 1925, a physical study of over 1,000 white Americans whose ancestors for three or more generations had been born in this country, is the most important study of its kind that has been made.

Hrdlička's interest in the origin and antiquity of the Indian led to critical examination of numerous finds of alleged geologically ancient man in America (*Skeletal remains attributed to early man in America*, 1907; *Early man in South America*, 1912; and others to 1937). In each instance his verdict was the same—a vigorous denial of antiquity. This uncompromising viewpoint was not relaxed even in the light of numerous discoveries in the West showing association of man with fossil vertebrates.

He made many trips to Europe and other parts of the world to examine sites and physical remains of paleolithic man (*The most ancient skeletal remains of man*, 1914; *The skeletal remains of early man*, 1930). He maintained that Neanderthal man was ancestral to *Homo sapiens*, in opposition to the prevailing theory that the Neanderthalers were a collateral branch that disappeared on the advent of modern man. His theory is supported by the recent discovery of paleolithic remains in Palestine that are intermediate in many respects between Neanderthal and modern man. In 1927 he received the Huxley Medal and presented the Huxley Memorial Lecture before the Royal Anthropological Society of Great Britain on *The Neanderthal phase of man*.

In 1918 Dr. Hrdlička founded the American Journal of Physical Anthropology and was largely responsible for establishing the American Association of Physical Anthropologists in 1928. The 1940 volume of the Journal was published in his honor, on his 70th birthday. In Czechoslovakia a similar honor was bestowed by another journal he had helped to establish, Anthropologie, the 1929 volume of which was issued in commemoration of his 60th birthday.

In 1896 Dr. Hrdlička married Marie S. Dieudonnee, who died in 1918. In 1920 he married Mina Mansfield, who survives him.

HENRY B. COLLINS, Jr.

ALLEN CULLING CLARK, member of this ACADEMY and one of its vice-presidents for many years, died on May 16, 1943. He was born in Philadelphia, Pa. on February 23, 1858, of New England parentage and became a resident of the District of Columbia when his family moved here in 1863. Educated in the District public schools and graduated in law from the National University Law School, he was admitted to the Bar of the District shortly after his twenty-first birthday.

In 1885 his vision of the future of insurance led him to found a company in West Virginia that later became the Equitable Life Insurance Co., of Washington. As secretary of this firm he worked long and earnestly for its growth, the entire financial policy being largely directed and controlled by him.

Mr. Clark had a sustained interest in historical research. Besides being the author of four books, he wrote about 40 historical papers, nearly all of which were published in the Records of the Columbia Historical Society. He took great care to ensure that his historical publications were accurate. Although his literary style was regarded as being that of an individualist, yet it did catch and hold the interest of the reader. He was honored each year beginning in 1916 by being elected president of the District of Columbia Historical Society. He was also a member of the Maryland, Virginia, and Mississippi Valley Historical Societies.

Mr. Clark married Sarah Pearce, who died in 1910. There were four children, all of whom are living.

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JOURNAL

OF THE

WASHINGTON ACADEMY OF SCIENCES

VOLUME 34 MARCH 15, 1944 No. 3

ETHNOLOGY.—*The requickening address of the Iroquois condolence council.*[1,2]

J. N. B. HEWITT, late ethnologist, Bureau of American Ethnology. (Edited by WILLIAM N. FENTON, Bureau of American Ethnology.)

INTRODUCTION

[As originally organized the presentation of the Requickening Address was postponed by an extended discussion of the League of the Iroquois, Deganawi'dah its founder, and an organic theory of social organization that seeks to explain certain characteristics of Iroquois social institutions, such as confederation, family, kin, clan, moiety, tribe, chiefship, and clan apportionment by tribe, the status of Iroquois woman, and the meaning of the symbolic council fire. These subjects, while pertinent to an understanding of Iroquois society, do not bear directly on the subject and appear therefore as explanatory notes after the text, while the discussion of the Condolence and Installation Ceremony itself is retained as introduction. Those readers who feel the need of background material on the League of the Iroquois may profit by reading the explanatory notes before plunging into the subject itself.]

The Requickening Address, the subject of this paper, is the third of five essential rituals used in the Condolence Council, which is the tribal convocation for condoling deceased federal chieftains and installing candidates in the vacant chiefships. In the order of their first appearance in the ceremony the five rituals of Condolence and Installation are: (1) Journeying on the trail, sometimes called the Eulogy or Roll Call of the Founders of the League; (2) Welcome at the Woods' Edge; (3) Requickening; (4) Six Songs of Farewell; and (5) Over the Great Forest. The Requickening

[1] Received November 26, 1943.

[2] The manuscript of this paper, originally entitled "The Requickening Address, or Fifteen Burdens, the Third Ritual of the Convocation to Condole the Dead Federal Chieftains (Yaa'nehr (M.)) and Install Candidates for Chiefship in the Council of the Iroquois League," is a revision of Mr. Hewitt's article "The Requickening Address of the League of the Iroquois" in the Holmes Anniversary Volume (1916), and it had been submitted for publication in 1936 shortly before his death. In later years, however, Hewitt's style, which had always been characterized by indirection and an attempt to translate Iroquois ideology into English that gradually acquired private meanings, had become so involved that many of his sentences needed recasting for reading. In the spring of 1939, shortly after I joined the Bureau of American Ethnology, the manuscript was turned over to me for revision. Aside from style, the text raised many points that needed clarifying in the field to render the discussion intelligible to other students. Since I had not been so long steeped in Iroquoiana as Hewitt, I found it profitable during field trips spread over 1939–1943 to take up various points in the manuscript with the brothers Simeon and Hardy Gibson, sons of the Late Chief John Arthur Gibson and nephews of Cayuga Chief Abram Charles, Hewitt's principal sources for the ceremonial texts. American ethnology should be grateful to the Gibson family for preserving these ancient political ceremonies. The editor acknowledges his gratitude for the help that present members of that family have extended him.

Initialed footnotes are by the editor (W.N.F.) unless attributed to the author (J.N.B.H.). Paragraphs enclosed in brackets are condensations by the editor and opinions of his informants. The editor does not necessarily subscribe to all opinions of the author.

Abbreviations employed to designate dialects of Iroquois are as follows: M., Mohawk; Oe., Oneida; Oa., Onondaga; C., Cayuga; and S., Seneca. The orthography of Iroquois words has been considerably simplified to eliminate diacritical marks commonly used in phonetic transcription of Indian languages, except the stress mark and the apostrophe for the glottal stop. Vowels have their common continental values. When long they are doubled; followed by "n" they are nasalized; and double "nn" occurring in the middle of a word denotes nasalization of the preceding vowel followed by initial "n" commencing the following syllable.—W. N. FENTON.

Address derives its distinctive name from its symbolic power and function of restoring life—requickening—through prescribed acts and set forms of words—to the dead chief in the person of a legally chosen clansman; and the name also derives from its ascribed power to requicken and heal the sorely wounded body and soothe the grief-stricken mind of a sorrowing cousin phratry of tribes; and this end is accomplished by raising up or installing a clansman of the deceased who shall bear the same official name and live instead of the dead lawgiver. Thus in the civil polity of the Iroquois peoples an office never dies; only its bearer dies. The name is one; the bearers are many.

Thus the five rituals for Condolence and Installation of chiefs comprised an institution of vital importance for maintaining the integrity and efficient functioning of the Iroquois state. It must be remembered, however, that this great convention of tribes was in no sense a funeral ceremony, since the dead officers had already been buried with fitting rites; but it was rather a memorial service for the honored dead, a fitting preparation of the mourners and of their unscathed cousin tribes for celebrating the investiture of candidates chosen for preferment. When all sorrow had been wiped away, the new candidate was shown and the antlers of office were placed on his head. Then followed a feast and a social dance, known as "rubbing their antlers together."

Power of the condolence ritual.—The Iroquois conception of the state, composed of statesmen and stateswomen and expressed in the ordinances of the League, required that the number of federal chiefs constituting the federal council should be maintained undiminished. And the elders, chiefs, and matrons of the Iroquois tribes looked to the *orenda,* or mystic power, which they believed was inherent in the words of the chants and in the rituals of condolence and installation themselves, for the preservation of their political integrity and welfare. The founders of the Iroquois League [whom Hewitt called prophet-statesmen], or at least their descendants, thought that this ceremony was so laden with magic power, which was useful in achieving welfare and yet so uncontrollable and sinister when evoked out of season, that it was believed imperative to hold this solemn assembly only in autumn or in winter. This was because the rites were so deeply concerned with the dead and with the powers that quicken and preserve the living from the hostile activities of the Great Destroyer that it was thought that the rites might be deadly and destructive to growing seeds and plants and maturing fruits, should their performance occur during spring or summer, the period of rebirth and growth. Their purpose in part was to nullify and overcome the destructive powers of Nature and to restore to its normal state the mystic potence of the stricken phratry of tribes. Indeed it was taught that the death of even one person weakened the *orenda* of the people, and naturally the death of a leader to whom the people looked for guidance was a much greater blow; and to restore the life of the people the several institutions for condolence and installation were devised to thwart the vicious assaults of death on the power of the people to live in health and peace.

The Requickening Address is noteworthy and unique in several important aspects. It sheds light on the psychology, mental stamina, and imaginative powers of the teachers and leaders of the Iroquois tribes during the Stone Age of America. Briefly, it portrays in symbolic language the unflinching mental courage and fortitude of these Indian state builders when sorely afflicted by the pain and sorrow occasioned by the death of respected leaders and when confronted with other imminent losses.

The role of the condoling phratry.—The Requickening Address dramatically portrays the celebrant, in the person of the speaker, as gathering together the torn and scattered remains of the stricken phratry of tribes; as bringing back to the devastated hearth of their council fire, while their adversary Death, the Great-faceless, hovers above them, the scattered fire-brands (i.e., the living federal chiefs) which were dispersed when the Great Destroyer in a rage kicked and stamped out the council fire with his feet; the speaker charges this being, who is a fiend by nature and who is faceless,

with having caused the present calamity; and he says that the grandfathers of the ancient times failed to recognize the lineaments of his face, but the Great Destroyer is conceived as going about at all times with his club couched at the very top of men's heads, and exulting: "It is I, I will destroy all things." Then the celebrant is portrayed as making preparations to undo and repair the destruction that this being has wrought; he pours the Water-of-pity down the mourner's throat before him and rearranges the organs in his breast and wipes away the gall-colored spots of bitterness engendered by grief from within his body; and finally he declares to the mourner before him, "Now, I have finished thy restoration. I now stand you back among the ranks of living men. Direct my eyes to the candidate to be installed. This is the sum of my words."

Thus, in highly redundant phrases, the Requickening Address paints in bold strokes the evils and wounds that daily befall a people—the calamitous effects of death's power over the lives and welfare of the mourning phratry of tribes; and it affirms that by counteracting the effects of these evils it restores the dying people to new life in the person of their newly installed chief.

Condolence law.—A fixed rule or regulation of the federal organization of the League was that in the event that one or more federal chiefs in either tribal phratry should die, the tribes of this moiety became mourners for a year, or until the vacant chiefships had been filled, in accordance with strict rules of civil and ritualistic procedure that governed the proceedings of the Condolence Council. At that time it is the official duty of the "cousin" tribes, "the unscathed ones," to perform the elaborate rites and ceremonies that are used to rehabilitate the mourning "cousin" tribes stricken by death, who, during the mourning period, can not, or may not, transact any public business.

More simply stated, the above procedure is reciprocity between moieties that obtains at the community and tribal level and is projected as custom law of the League. In the deaths of individuals, the clans of the opposite moiety to that of which the deceased was a member invariably conduct the rites, and the clans of his phratry are likewise mourners. In the League, whole tribes play the roles of clans.]

The loss of one person from an *Ohwachira* (uterine or maternal family) is indeed great; and it was thought necessary to restore this loss by replacing the lost person by one or more persons, according as the deceased was of more or less importance and standing in the community. [This principle operated in the adoption of prisoners in ancient times, and it functioned in the succession of chiefs until recently.]

In Iroquois polity it was not the duty of the members of the bereaved blood-kin group [bilateral family (Goldenweiser)], maternal family, or clan to effect this replacement; but it was rather the duty and obligation of all those persons of alien maternal families who are connected by marriage with the afflicted maternal family, and who are specifically called *ronton'ni* (masc. pl.), or sadon'ni (2d person sing.); the noun stem being *-ton'ni*, or *-don'ni*. [There is no term in the English language that satisfied Hewitt for translating this term, but *Adon'ni* means approximately "my father's lineage."]

[It is interesting and necessary, Hewitt thought, to submit tentatively the following definitions of the term: *Adon'ni* (in certain dialects the *d* is softened to *t*) denotes all tribes, the maternal families of whose clans have contracted marriage, through males, with the maternal family of ego. The group of which *Adon'ni* is a specific name includes all of the men and women of the maternal families, clans, and tribes, who have contracted marriage relationships with ego's maternal family, and therefore it includes the father of ego. In other words, it is ego's father's lineage.

This raises a nice theoretical point. If Hewitt's definition of this term is carried to its logical conclusion, it sets up the conditions for original moiety exogamy among the Iroquois tribes, in which clan and phratry (or moiety, for there are only two phratries) behave as if there were two intermarrying lineages with maternal descent.]

The articles of the ritual of the Requick-

ening Address end with this term, and so may be applied to either the Father side or the Mother side, the use of course depending on the side from which the celebrant (speaker) of the ritual is chosen.[3] It is thus seen that the translation of this term by "Father's Brothers" does not include all the persons named by it.

The version of Chief John A. Gibson.—Sometimes the ritual has been recited in "blank verse" by the great native speakers of a past generation. [Hewitt had heard it so rendered, but the text from which he made the following translation is not in that form. The original is a carefully revised Onondaga Iroquois text, which was dictated to Hewitt by the late highly esteemed Federal Chief John Arthur Gibson, bearer of the chiefship title, Sganyadai'iyo', "Handsome Lake," the first title on the Seneca list, and representing the Turtle clan. At the time the dictation was made Chief Gibson had been completely blind for 24 years. During this time he had represented the Seneca of his maternal family in the Federal Council of the Six nations of the Iroquois on Grand River, Ontario, Canada. Born of a noble lineage, he became an astute and worthy expounder of the ideals of Deganawi'dah, founder of the League of the people of the Longhouse.

Somewhat later, this text was revised with the aid of two other federal chiefs, Abram Charles (Cayuga), who died in 1929, and John Buck, Sr. (Onondaga), also deceased. Only minor corrections and amendments were found necessary.]

Chief Gibson, a Seneca, who spoke Onondaga or Cayuga equally well, was for years principal speaker for the Onondagas at all their ceremonies, and consequently he dictated the form of Requickening Address in use by his phratry, "the Three Brothers," who are also called "*Adon'ni*," and are composed of the Mohawk, Seneca, and Onondaga tribes. By substituting the words "the Two Brothers," i.e., the Oneida and Cayuga tribes, instead of the words "the Three Brothers," and also the word "My Child" or "My offspring," and the kinship terms arising from this relationship, the form of this address would then be the one used by the tribal phratry, which Hewitt called Mother or Offspring, that the Iroquois sometimes refer to as the Younger Brother Nations. [In modern times, since the admission of the Tuscarora, Tutelo, Nanticoke, and Delaware tribes to the latter phratry of tribes, the phrase "the Four Brothers" has displaced that of "the Two Brothers," which obtained until the beginning of the eighteenth century.]

"*Fifteen Matters.*"—In its full form the Requickening Address consists of 15 articles but only when condoling for a chief that was murdered. For an ordinary condolence *only 14* articles are used; and so, commonly, it is called "The Fourteen Matters." These are accompanied in delivery by 14 skeins or strings of wampum as attesting tokens, which the Onondaga call *Ne''Adon'daksh'hä'*, freely rendered, "the *Attestations.*"

The Address is composed of two parts, the first part containing 3 and the second part 12 of the 15 burdens. The first part is spoken or intoned by an appointed speaker from the *unscathed* tribal phratry beside the temporary fire, which is lighted beside the thorny bushes which fringe the forest and cleared lands surrounding the lodge-of-assembly [longhouse]; whence its name, "The fire-beside-the-thorny-shrubs" or simply "At-the-woods'-edge." The fire is kindled by a brand drawn from the principal-fire in the lodge-of-assembly by the bereaved tribal phratry for the express purpose of greeting the visiting tribal phratry with the Chant of Welcome. Of course, either moiety of tribes may be in the role of the unscathed because at that time it is not in mourning.

The three articles or burdens of the first part deal with the eyes, ears, and throat of the bereaved phratry and derive their names from their supposed function of restoring fully the faculties of seeing, hearing, and speaking, which had been destroyed or at least impaired by the shock of the chief's dying. (Figs. 1, 2, 3.)

[3] In actual practice, however, the term is customarily used by the Four Brothers' side (Oneida, Cayuga, Tuscarora, and Tutelo) in addressing the Three Brothers' side (Mohawk, Onondaga, and Seneca) in this particular ceremony. Thus it appears on the texts collected by Hewitt and Goldenweiser, and all of my informants affirm it.—W.N.F.

The late Cayuga Chief Abram Charles [who died February 14, 1929], was a profound student of the origin and laws and institutions of the League of the Iroquois. [Chief Charles was able to explain to Hewitt's satisfaction the actual or traditional facts underlying certain obscure rites and passages in the native records.] Chief Charles alone of all my native informants was able to give me, for example, the traditional reason for kindling the temporary fire "Beside-the-thorny-bushes," where the first three articles or burdens of the Requickening Address are intoned by a celebrant for the unscathed phratry.

It was after an acquaintance of more than 12 years that Chief Charles concluded that the writer [Hewitt] could appreciate the reasons for kindling this temporary fire "Beside the Thorny Bushes." In reply to a question which had been asked in previous interviews, Chief Charles is quoted:

> In olden times when death had ruthlessly stricken a loved one, the nearest kindred would indulge in excessive, even frantic, expressions of grief, commonly casting herself on the hearth among the ashes which were thrown over the head and shoulders, there to mix with tears and drivel from the mouth and with blood oozing from many lacerations on the body; there the mourner remained for long periods of time, until the bitterness of grief would in a measure become assuaged.

Naturally, a mourner in such condition would not be thought fit to appear in public at a formal assembly of chiefs of allied tribes. So by analogy, a tribe or phratry of tribes, which had lost its trusted leader, was likened to such a mourner writhing on her ash heap; and therefore, before taking a seat in a formal assembly at which representatives of neighbor peoples would be present, it was thought proper and necessary, as Chief Charles quaintly declared, "to clean up a little bit" by wiping away the tears, by dislodging the obstruction in the ears, and by clearing from the mourner's throat the accumulated mucus and phlegm. Such, it seems, was the courtesy due to the afflicted mourning phratry.

This closes the prescribed ceremonies "Beside-the-thorny-shrubs," and then the two tribal phratries separately enter the lodge-of-assembly (longhouse) from opposite sides, a warrior chief of the mourners leading the condolers by the arm. Then, after three other chants—Eulogy of the Founders, Six Songs, and Over the Great Forest— have been sung alternately by the two tribal moieties, then the twelve remaining articles or burdens of the Requickening Address are delivered; first by the condoling moiety and later by the mourners, when the wampum strings which accompany each "word" are returned across the fire. Each burden recites an injury to life but affirms its cure within the hour by virtue of the *orenda*, magic power, inherent in the rites and in the very words spoken by the celebrant.

For convenience, or by custom, when intoning the 12 articles or burdens each message is accompanied by a string or skein of wampum beads; the first three should be attested likewise, but these confirming strings are customarily omitted from the ceremony, and on such occasions it is said, referring to this omission, "Our words are bare and clear."

All the five chants making up the ceremony of condolence and installation are, with a single exception, the Eulogy, used in two parts, between which like parts of other chants are regularly interpolated. [Although this type of reciprocal singing, first by the leading moiety and then by the other moiety, is characteristic of other Iroquois ceremonies, this peculiar method of interlocking the parts of these chants remained a moot question with Hewitt.]

At least six hours of ceremonial activity intervene between the delivery of the Three Burdens of the first part At-the-Woods'-edge and the recitation of the Twelve Burdens of the second part of the Requickening Address. [Since the first part occurs third on the program, Hewitt called it the Third Chant; the second part, however, concludes the main features of the Condolence Council. There remain only the Installation, or Charge to the New Chief, a terminal feast, and a social dance in the evening.]

When the closing words of the Chant fo Welcome, solemnly congratulating the visiting cousin phratry for its safe arrival At-the-woods'-edge, have been intoned by the

appointed chanter in behalf of the bereaved tribal phratry, then the chosen speaker for the *unscathed* tribal phratry, whose minds are filled with pity, stands beside the ashes of the wayside fire-pit and intones the first three articles or burdens of the Requickening Address, called "The Tears," "The Ears," and "The Throat."

TEXT OF THE REQUICKENING ADDRESS

FIRST PART

THE FIRST ARTICLE—TEARS: OR ONE'S EYES

The Orator says:

Oh, my offspring,[4] lo, verily, this present day, such as is this day in kind and aspect, He Himself, He the Finisher of our Faculties, He the Master of All [Dehayenhyaawa''gih] (He the Sky rememberer), has made. Even He has prepared the light of this day, such as it is (I say).

Now therefore, they who are customarily called the Three Brothers are journeying along the path of the Ritual as it was prepared for us by our forefathers upon whom our minds rested in confidence (I say).

It is that, therefore, that brings their persons here, the calamity, so hopeless and dreadful, which has befallen thy person, this one (*indicating*), thou whom I have held in my bosom, thou noble one [Sayaa'neh Federal Chief] the two of you who are the Two Brothers (The Oneida and the Cayuga) (I say).

It is that, therefore, as to that, verily, this present day, I thrust aside the door-flap from the place where thou art lying as an object that is black; it is that in the midst of great darkness thou art sitting too prone in grief, thy back alone visible in the thick darkness (I say). Thou whom I have weaned.

It is that, therefore, that I shall stoop low there at the edge of thy ash-pit, grasping my knees, and that, therefore, I shall utter such words that I shall with them soothe and appease by caresses any displeasure of thy guardian spirit (I say).

It is that, therefore, that I come for the sake of my Offspring (i.e., the mother's side) (I say)).

It is that, therefore, that this present day, we, thou and I, seat outselves side by side, and that, therefore, it is here in the very midst of very many tears (I say).

It is that, therefore, that the cause of it, indeed, of the dreadful thing that has stricken thy person, this one (*indicating*), thou noble one whom I have been wont to hold in my bosom (I say).

It is that, therefore, that now today has been caused to be vacant the seat of husk matting, the place whereon he who was a co-worker with thee, and upon whom rested the eyes of the wise minds in full confidence, was wont to be seated (I say).

It is that, therefore, that has caused it to be so, the being that is demonic in itself, the being that is faceless because its lineaments were unknown to our ancestors, the Great Destroyer that it is, which every day and every night roams about with its weapon couched, yea, uplifted, at the very tops of our heads, wherein it and its kind desiring it, and so they severely boast "It is I, I will destroy all things, even the Commonwealth of the League" (I say).

It is that, therefore, that there it delivered a vital stroke whereby it snatched away from thee one in whom thou didst trust for words of wisdom and comfort; and now in his turn it has borne him away, it may be indeed, now, therefore, today, thou dwell amidst many tears (I say).

It is that, therefore, oh, thou my offspring, thou *yaa'nehr* (thou Federal Chief), are not thy Father's blood-kin, the Three Brothers, making their preparations, and now, therefore, let them say "Now do we pass our hands through thy tears in sympathy; now, we wipe away the tears from thy face, using the white fawn-skin of pity." Now, therefore, let them say, "We have wiped away thy tears." Now, therefore, in peace of mind, thou wilt continue to look around thyself, enjoying again the light of the day. Now, also, thou wilt again behold what is taking place on the earth, whereon is outspread the handiwork of the Master of All Things. Now also thou wilt again see thy sister's sons and daughters (thy nephews and nieces), as they move about thy person, even to the least of them, the infants. Now, thou wilt see them all again (I say).

Now, therefore verily, thou wilt again do your thinking in peace, this one, my offspring,

[4] Cayuga say: howeyanen'don'.

thou *yaa'nehr* (Federal Chief), thou whom I have been wont to hold in my bosom (I say).

Enough, therefore, verily, that even for one brief day, also in peace, mayst thou do thy thinking (I say).

Thus, perhaps, let them do, The Three Brothers, who had been so called ever since the establishment of their affairs (the institution of the League) (I say).

Now, therefore, do thou know, this one, my weanling, that now the Word (attested by wampum strings) of thy *Adon'ni* is on its way hence to thee. (Fig. 1.)

THE SECOND ARTICLE—THE EARS: HEARING

Oh, my offspring, there is a different matter, and we will say as we continue to speak that it comes to pass where a great calamity has befallen one's person that the passages of the ears become obstructed and the hearing is lost. One then hears not the sounds made by mankind, nothing of what is taking place on the earth.

It is that, therefore, that this dreadful thing has indeed befallen thy person, thou my weanling, thou, you Two Brothers (I say), thou *yaa'nehr* (Federal Chief).

Is it not then true that what has befallen thy person is so calamitous that it must not be neglected? Indeed, now thou hearest nothing of the sounds made by mankind as they move to and fro about thy person, nor anything of what is taking place on the earth. Now, therefore, let the Three Brothers say, "We have made our preparations, and so we proceed to restore thy person by removing the obstacles obstructing the passages of thy ears." Now, therefore, thou wilt again hear when one will address words to thee on whatever matter it may be, words which may be directed to thee personally, thou *yaa'nehr* (Federal Chief), and next in order, the sounds made by thy sister's sons and daughters (thy nephews and nieces), moving around thy person. Now, thou wilt again hear all things, also all that is taking place on the earth, all these things thou wilt again hear. And, now, also thou wilt be able to hear clearly when we Three Brothers address you ceremonially in the Chief Place (I say).

It is that, therefore that we do this that even for one brief day also in peace, mayst thou do thy thinking, thou, my offspring, thou *yaa'nehr* (Federal Chief), thou, my weanling (I say).

Thus, perhaps, let them do, the Three Brothers, who had been so denominated ever since the establishment of their affairs (namely, the institution of the League) (I say).

Now, therefore, do thou know, this one, my weanling, that now the Word (attesting wampum strings) of thy *Adon'ni* is on its way hence (to thee) (I say). (Fig. 2.)

THE THIRD ARTICLE OR BURDEN: THE THROAT

Oh, my offspring, there is still another matter to be considered now, and we will say, as we continue speaking, that it comes to pass where a great misfortune has befallen a person, where the Great Destroyer has been harshly cruel, that the throat of the flesh-body becomes sorely obstructed, so that then it is plainly to be seen that the vitality of the person's life has become lessened, also that of the mind of that person (I say).

Verily, therefore, this has happened to thy person, this one, my offspring, thou *yaa'nehr* (Federal Chief), this one, whom I have been wont to hold in my bosom.

Is it not then the fact that what has befallen thy person is so dreadful that it must not be neglected? Is it not true that thy flesh-body has become choked up? Now, verily, thou canst breathe only with great difficulty, also thou art not able to say anything except in distress. Now, therefore, surely the powers of thy life are greatly weakened by it (I say).

Now, then, verily, let the Three Brothers declare: We have now made our preparations, and now, therefore, we remove from thy throat of thy flesh-body again the throttling obstructions (I say).

Now, verily, again thou wilt breathe with ease and comfort, and now, too, thou wilt again move thy members with ease (I say). Now, too, thou wilt again speak with pleasure when soon we, thou and I, will mutually greet each other in the Chief Place (I say).

It is that, therefore, that we do this, that even for one brief day, and also in perfect peace, mayst thou do thy thinking, thou my offspring, thou *yaa'nehr* (Federal Chief), this one (*indicating*) whom I have been wont to hold in my bosom (I say).

In this manner, perhaps, let the Three Brothers, so denominated ever since the time they had established their Commonwealth, do this (I say).

Now, therefore, my weanling know it, that the Word (attesting wampum strings) of thy Father's Kinsmen, is on its way hence (to thee) (I say). This is the sum of our words at this place. (Fig. 3.)

(Remember that these three articles of the Requickening Address are delivered at the rites which take place at the Fire-kindled-near-the-thorny-bushes, marking the limits between the forest and the clearing surrounding the Lodge of Assembly, usually called, "The-fire-beside-the-thorns." The remaining 12 articles, except one, are reserved for later presentation in the Lodge of Assembly, as already explained above. The article omitted is the one used only in case of a murder.)

SECOND PART

THE FOURTH ARTICLE OR BURDEN: WITHIN HIS BREAST

The Orator of the unscathed visiting tribal sisterhood now continues: Oh, my offspring, now there is still another thing that ever occurs wherever and whenever a great calamity has befallen a person; verily, this affliction comes when the being demonic of itself, the Faceless One, the lineaments of whose face our ancestors failed to discern, the Great Destroyer, puts forth excessive ferocity against one.

It is ever true that the organs within the breast and the flesh-body are disordered and violently wrenched without ceasing, and so also is the mind, Now, verily, therefore, there always develop yellow spots within the body. Verily, now, the life forces of the sufferer always become weakened thereby. This ever takes place when the Great Destroyer puts forth excessive ferocity against one in causing such great affliction (I say).

Oh, my offspring, thou art now such a sufferer, Oh, my offspring, verily, in this manner too thou hast suffered this affliction, this one, thou *yaa'nehr* (thou Federal Chief) (I say).

Is not what has befallen thee then so dreadful that it must not be neglected? For, at the present time, there are wrenchings without ceasing within thy breast, and also within thy mind. Now truly, the disorder now among the organs within thy breast is such that nothing can be clearly discerned. So great has been the affliction that has befallen thee that yellow spots have developed within thy body,[5] and truly thy life forces have become greatly weakened thereby; truly thou dost now suffer (I say).

It is that, therefore, that in ancient times it thus came to pass that the hodiyaane'hshon', the Federal Chiefs, our grandsires, made a formal rule, saying, "Let us unite our affairs; let us formulate regulations; let us ordain this among others that what we shall prepare we will designate by the name, The Water-of-pity (Djawakahon'den') and which shall be the essential thing to be used where Death has caused this dreadful affliction, inducing bitter grief."

And, so, in whatever place it may be that such a tragedy will befall a person, it shall be the duty of him whose mind is left *unscathed* by it to take up and make use of the "Water-of-pity," so denominated by us, by taking it in hand, and then by pouring it down the throat of the one on whom the great affliction has fallen; and, it shall be that when the "Water-of-pity" shall have permeated the inside of his body, it will at once begin the work of reorganizing all the many things there which have been disarranged and disordered by the shock of the death, not only in his body but also in his mind; and it will also remove utterly all the yellow (gall) spots from his throat and from the inside of his body (I say).[6]

Oh, my offspring, this great tragedy has befallen thee too. Do thou know it, therefore, that now the Three Brothers so called from the beginning have made their preparations. Now, verily, therefore, they take up the "Water-of-pity" and now, then, let them say, We now pour into thy body the "Water-of-pity." Oh, my offspring, it shall, therefore, come to pass when this "Water-of-pity" settles down in thy body it shall at once begin the work of restoring to order the organs which have been disarranged and disordered in thy body, and will bring order to thy mind also; all things will be restored and readjusted, and also all the yellow (gall) spots in thy body will be severally cleared away from thy body; now, therefore,

[5] These yellow spots are symptoms of "gall trouble" for which the Iroquois regularly take emetics in springtime.—W.N.F.

[6] The "Water-of-pity" that is poured down the mourner's throat is consonant with other Iroquois medical practice. The midwife drops an infusion of poplar bark down the baby's throat to purge its bowels, and the council of animals cure the good hunter by dropping the sacred Little Water Medicine down his throat and revive him. —W.N.F.

all things shall be in good condition as to the powers of thy life. Then, therefore, there will be health and comfort in thy life (I say).

Thus, therefore, for one brief little day mayst thou think thy thoughts in peace, thou noble one, thou *yaa'nehr* (Federal Chief), whom I have been wont to hold in my bosom (I say).

In this manner, then, it may be, let the Three Brothers, so denominated ever since they established their Commonwealth expedite this matter (I say).

Now, therefore, do thou know it, thou noble one, thou whom I have been wont to hold in my bosom, thou *yaa'nehr* (Federal Chief), that the Word (attesting wampum string) of thy *Adon'ni* is now on its way hence to thee (I say). (Fig. 4.)

THE FIFTH ARTICLE OR BURDEN: THE BLOODY HUSK-MAT BED

Now, Oh, my offspring, there is still another matter to be considered at this time.

It is this, that it invariably comes to pass where a great calamity has befallen a person that a trail of blood is smeared over the husk-mat couch of that person. Now, invariably of course that one's place of rest is not at all pleasant, sitting cross-legged in wretchedness (I say).

Thus, therefore, art thou stricken in thy person in this very manner, Oh, my offspring, whom I have been wont to hold in my bosom, thou noble one, thou *yaa'nehr* (Federal Chief). Is not then what has befallen thy person so dreadful that it must not be neglected? Now, at this time is there not a trail of blood smeared over thy husk-mat couch? Today, thou dost writhe in the midst of blood (I say).

Now, therefore do thou know it, that the Three Brothers have made their preparations, that now, therefore, let them say it, "Now, then, we wipe away the several bloody smears from thy husk-mat resting place. That, therefore, we have employed the skin of the spotted fawn (=words of pity and comfort) to wipe away the bloody trails from thy husk-mat" (I say).

That that, therefore, shall come to pass, there will be a day at some future time when our minds shall again be parted. And that that shall be, therefore, when thou shalt arrive again where thy husk-mat couch is, it shall be in the highest degree peaceful and pleasant when thou wilt resume thy seat where thou art wont to rest (I say).

Thus, therefore, may it be that for the one poor brief day, also in peace, thou mayst carry on thy thinking in contentment, this noble one, thou *yaa'nehr* (Federal Chief), whom I have been wont to hold in my bosom (I say).

In this manner, perhaps, let the Three Brothers, so denominated ever since their Commonwealth was completed, do this.

Now, therefore, do thou know it, Oh, my offspring, that the Word (attesting wampum string) of thy *Adon'ni* is on its way thence to thee (I say). (Fig. 5.)

THE SIXTH ARTICLE OR BURDEN: THE DARKNESS OF GRIEF[7]

Now, Oh, my offspring, there is still another matter to be considered at this time.

It is this, that where a direful thing befalls a person, that person is invariably covered with darkness, that person becomes blinded with thick darkness itself. It is always so that the person knows not any more what the daylight is like on the earth, and his mind and life are weakened and depressed (I say).

This very thing, then, has befallen thee, my weanling, thou noble one (Federal Chief), whom I have been wont to hold in my bosom.

Is not then what has befallen thy person so direful that it must not be neglected? Now, therefore, at this time thou art become thick darkness itself in thy grief. Now, thou knowest not anything of the quality of the light of day on the earth (I say).

Now, Oh, my offspring, do thou know it, that now the Three Brothers have made their preparations, and now, therefore, let them say, "Now therefore, we make it daylight again for thee. Now, most pleasantly will the daylight continue to be beautiful when again thou wilt look about thee whereon is outspread the handiwork of the Finisher of our Faculties on the face of the earth" (I say).

Thus, therefore, for one brief little day mayst thou think thy thoughts in peace, thou noble one, thou *yaa'nehr* (Federal Chief), my weanling (I say).

In this manner, then, perhaps, let the Three Brothers, so denominated ever since they estab-

[7] When a chief dies, everything gets dark, hence the "Deep Darkness" of grief is as the night.—S. GIBSON.

lished their Commonwealth, effect this matter (I say).

Now, therefore, do thou know it, my offspring, thou noble one, thou whom I have been wont to hold in my bosom, thou *yaa'nehr* (Federal Chief), that the Word (attesting wampum string) of thy *Adon'ni* is on its way hence to thee (I say). (Fig. 6.)

THE SEVENTH ARTICLE OR BURDEN: THE LOSS OF THE SKY

Oh, my offspring, now there is another matter to be considered at this time.

It is that, then, that where a great calamity has befallen a person it invariably comes to pass that the sky is lost to the senses of that person; invariably he does not know anything of what is taking place in it (I say).

Verily, my offspring, this very thing has befallen thy person, thou noble one, thou *yaa'nehr* (Federal Chief). Verily, then is not what has befallen thy person not to be neglected? Now, therefore, the sky is completely lost to thy view. Now, thou dost know nothing of what is taking place in the sky (I say).

So, now, therefore, do thou know it, that now the Three Brothers have made their preparations, and now then let them say, "Now, then, we beautify again the sky for you. It shall now continue to be beautiful. Now, thou wilt do thy thinking in peace when thy eyes will rest on the sky. The Perfector of our Faculties, the Master of All Things, intended that it should be the source of happiness to mankind" (I say).

Thus, therefore, for one brief little day, also in peace, mayst thou do thy thinking, thou noble one, thou *yaa'nehr* (Federal Chief), my offspring (I say).

In this manner, perhaps, let them do it, the Three Brothers, so denominated ever since they had established their Commonwealth (I say).

Now, therefore, do thou know it, my offspring, that the Word (attesting wampum string) of thy Father's blood kin is going hence to thee (I say). (Fig. 7.)

THE EIGHTH ARTICLE OR BURDEN: HIS SUN IS LOST

Oh, my offspring, now there is still another matter for serious thought. Thus it invariably comes to pass where a great calamity has befallen a person that the Sun is lost to that person's senses. Then such a person knows nothing about the movements of the Sun, nothing of its drawing nearer and nearer to him; he is then in darkness (I say).

This very thing, therefore, has happened to thee, my weanling, thou noble one, thou *yaa'nehr* (Federal Chief). The Sun is now lost to thee. Verily, then, is not what has befallen thy person not to be neglected? No more art thou aware of the movements of the Sun, nothing of its drawing nearer and nearer to thee (I say).

So, now therefore, do thou know it, that the Three Brothers have made their preparations. Now, then, let them say it, "Now, we attach the Sun again in its place for thee; that then shall come to pass when the time shall come for the dawning of a new day, that verily thou shalt see the Sun when it shall come up out of the horizon, when, indeed, our Elder Brother (The Sun), who lights up the earth shall come over it" (I say).

Thus, then, my offspring, thy eyes shall rest on it as it draws ever closer to thee. That, therefore, when the Sun shall reach, or place itself in mid-heaven then around thy person rays or haloes of light will abundantly appear. Then, indeed, shall thy mind resume its wonted moods; then also wilt thou remember the many things of whatsoever kind they may be, pertaining to the welfare of thy people, thy children, and thy grandchildren, matters, indeed, in which thou hadst been toiling (I say).

Thus, then, may it be, that for one brief little day thou mayst do thy thinking in peace, thou noble one, thou *yaa'nehr* (Federal Chief), thou my weanling (I say).

In this manner, therefore, let the Three Brothers, so denominated ever since the institution of their Commonwealth, do this.

Now, therefore, do thou know it, my offspring, that the Word (attesting wampum string) of thy *Adon'ni* is on its way hence to thee (I say). (Fig. 8.)

THE NINTH ARTICLE OR BURDEN: THE HEAP OF CLAY ON THE GRAVE[8]

Oh, my offspring, now, again, there is another matter for consideration. Now, this other

[8] This refers to the mound of freshly upturned earth or clay over a new grave. Chief Charles gave the Onondaga form heyo'daägwaiį̨'d̨a'; Cayuga is heyo'däa'gwa'ont. Simeon Gibson thought it odd of his uncle to confuse the two forms. Symbolizing death, the string is entirely black.

things concerns the course of action caused in a case where a great tragedy has stricken a person, where it occurred with outrageous harshness, for invariably the mind of that person is simply tossed and tormented on the grave of him in whom he fondly trusted.

So then this self-same thing has happened to thee, thou noble one, thou *yaa'nehr* (Federal Chief). Now, it is that thy mind is simply lying there on the grave of the one whom thou didst trust. Is not what has befallen thee so serious that it must not be neglected? So, therefore, do thou know it, that the Three Brothers have completed their preparations, and let them say, "We now level the rough ground over the grave of him in whom thou didst fondly trust." Now, then, they place over it a fine slab of wood, and now too they pull up several kinds of grasses which they will cast on it for, truly, there are two different things that always take place during the days and during the nights; one is that it may become very hot, but now it will then not reach into the place where his corpse lies; the other is that it may rain heavily, but now it will then not reach the place where his bones lie (I say). And so the bones of him on whom thou didst fondly trust shall rest peacefully and undisturbed (I say). (Fig. 9.)

THE TENTH ARTICLE OR BURDEN: THE INTERPOLATED CLAUSE: TWENTY IS THE PENALTY FOR HOMICIDE[9]

And, more than this, we now restore thy land to orderliness, and now the Three Brothers say, "We have pity for your lost homeland. Now, we rush forward, throwing ourselves here and there, in that we may now gather together again thy other bones, so widely scattered as they have been by the Being Malefic in Itself, the Being that is Faceless—the Being that is the Great Destroyer—Death" (I say).

More than this (I say), that our departed grandsires made a ruling, in that they said that twenty (strings of wampum) shall be the value of this [i.e., *a death by murder*], at that price did they fix it, in that they denominated it by this: That it shall be worth (or valued at) twenty (strings of wampum); they declared that one shall bind their bones thereby [i.e., to keep them from being murdered by a clan or tribal enemy] (I say).

[9] Cf. Hewitt, *The Requickening Address of the League of the Iroquois*, p. 174. 1916.

Do thou know it, furthermore, this one (*indicating*), my offspring, that now, do not the Three Brothers take that up now, and that now, completing their preparations, let them say it, "Now, we bind thy bones one and all, restating the value of twenty (strings of wampum) on them" (I say).

Now, then my offspring, thou wilt again do thy thinking in peace in future. Thus, therefore, let it be, that for one brief little day thou mayst do thy thinking in peace and contentment.

In this manner, therefore, let the Three Brothers, so denominated ever since they had established their commonwealth, do this (healing act) (I say).

And, now, my offspring, do thou know it, that the Word (attesting wampum string) of thy *Adon'ni* is on its way hence to thee (I say). (Fig. 10.)

THE ELEVENTH ARTICLE OR BURDEN: THE COUNCIL FIRE

Now, another thing (I say): That our grandsires, now long dead, and in whom our minds rested in trust, decreed, because they did not know its face, the face, indeed, of that Being that abuses us every day, every night, that Being of Darkness, lying hard by the lodges where it is black night, yea, that Being which here at the very tops of our heads, goes about menacing with its couched weapon—with its uplifted hatchet—eagerly muttering its fell purpose, "I, I will destroy the Work—the Commonwealth," they decreed, I say, that therefore they would call it the Great Destroyer, the Being Without a Face, the Being Malefic in Itself, i.e., Death.

More than this it has already done; it has put forth its lethal power there in thy frail lodge of bark, this one (*indicating*), my weanling, my offspring, thou noble one, and so snatching therefrom one on whom thou didst depend for words of wisdom and kindly service.

And so now, at this very moment, there is in that lodge of bark a vacant mat because of this stroke.

And, in striking this cruel blow, it scattered the Fire-brands (i.e., the yaa'nehr or the Federal Chiefs) widely asunder from the place where thou art wont to kindle thy (Council) Fire, and, now, more than this, the Great Destroyer has danced exultingly stamping that hearth under foot.

Thou sittest there now with bowed head; thou no longer dost meditate on anything whatsoever of thy former affairs—wherein thou wast laboring for thy niece and for thy nephew, i.e., the men and the women of thy people; yea, for thy children, and also for thy grandchildren, who run about thy sides, and for these also who are still swathed to cradle-boards, and also for those children who, still unborn, whose faces, still underground, are coming toward thee; yea, for these warriors and for these women; that is the extent, indeed, of the solicitude and vigilant care which were in the hands of him, thy uncle —thy mother's brother—who has departed, while he labored for their daily welfare, and who at this moment is floating away far homeward (I say).

So, now, do thou know it, this one, thou *yaa'nehr*, my offspring, thou noble one, that the Three Brothers have perfected their preparations, and so let them say it, "Now, we gather again the scattered Fire-brands [i.e., the Federal Chiefs], and now, indeed, do we rekindle the (Council) Fire for thee. And now, in fact, verily, the smoke shall rise again, and that smoke [=the business of the Council] will be fine, and it will even pierce the sky."

So, now again, the eyes of the peoples—alien to us, perhaps—shall see again, also, the full number of our Council Fires [i.e., the tribal governments].

Now, again, indeed, we raise thee up to full stature, erect among thy people. We also cheer up thy mind. More than this, we again set thee in order around the place where we have rekindled the (Council) Fire for thee, my offspring.

Let the Three Brothers, furthermore, say it, "Do thou again transact the business upon which thou wert hitherto engaged promoting the welfare of the prosperity of thy families (ohwachira)."

Thus, furthermore, let it be so, that for one poor short day, thou mayst continue to think in peace, thou *yaa'nehr*, my offspring, thou noble one, my weanling.

In this manner, then, shall they now perform this duty of requickening, the Three Brothers, so denominated ever since their affairs had been completed (I say).

Lastly, more than these things, do thou know it, thou *yaa'nehr*, my weanling, thou noble one, that the Word (attesting wampum string) of thy *Adon'ni* is now going hence to thee (I say). (Fig. 11.)

THE TWELFTH ARTICLE OR BURDEN: THE CREATOR'S ASSISTANTS—MATRON AND WARRIOR. (Fig. 12.)

Now, there is another thing to be considered, today (I say). It is that wherein the Perfector of our Faculties who dwelleth in the sky did establish this matter, in that He desired that He should have assistants everywhere, even down to the earth, that these latter assistants shall devote their solicitous care to the number of matters which pertain especially to the earth, and which, I have ordained, He says, one and all.

It is that, in fact, that first among others, He caused the body of our mother—the woman—to be of great worth and honor. He purposed that she shall be endowed and entrusted with the duties pertaining to the birth—the becoming—of men, and that she shall, in the next place, circle around the fire in preparing food,—that she shall have the care of all that is planted by which life is sustained and supported, and so the power to breathe is fortified; and moreover that the warriors shall be her assistants (I say).

So that, too, is a great calamity, that, it may be, the Great Destroyer will make a sudden stroke there in the ranks of our mothers, and that he will thus snatch away one there, so that her body shall fall. The evil of this misfortune is that a long file of expected persons shall fall away, which, indeed, would have come in the many-fold lines of grandchildren who would have been born from her in the future.

In that case, moreover, her assistants, the warriors, will then just stand around listlessly, but grieving.

For, now, that one on whom they so much depended is now, very probably, floating away to the homeland, and now the minds of all those who still remain have fallen low (in grief) (I say).

So now, moreover, the Three Brothers, having perfected their preparations, do say, "Let us comfort them now and raise up their minds." And that, indeed, shall happen—they will now again devote themselves to their cares and their duties (I say).

[Hoyaa'neh, the Federal Chief. (Fig. 13.)]

More than this, now, thou *yaa'nehr*, thou noble one, my offspring, thou hast a nephew and a niece, that is to say, the warriors and the women. They are and shall be thy immediate care (I say).

And that more than this (I say), thou *yaa'nehr*, thou noble one, thou shalt and must give a full hearing to whomsoever will speak to thee for counsel or for service. That, too, let the Three Brothers say, "Do ye heed and obey one another." It is, in fact, a grievous thing, should it be that thou, noble one, should cast over thy shoulder whatsoever word is spoken to thee.

That mood of mind may have place only when the time is near in which the feet of thy people will hang over the abyss of the sundered earth (of impending ruin). There is no one dwelling beneath the sky who has the power to come out therefrom, when that shall have come to pass. Furthermore, this great responsibility rests both upon thee and upon thy niece and thy nephew—that ye listen to and obey one another (I say).

Thus, too, let it be done, that for one poor short day, thou mayest continue to think in contentment, my offspring, thou noble ruler, whom I have been wont to hold in my bosom.

In this manner then, perhaps, let them do it, the Three Brothers, so denominated ever since they were in the prime growth of their affairs (I say).

Now, more than this, do thou know it, this one (*indicating*), my offspring, thou noble ruler, whom I have been wont to hold in my bosom, the Word (attesting wampum string) of thy *Adon'ni* is on its way hence to thee (I say). (Figs. 12 and 13.)[10]

THE THIRTEENTH ARTICLE OR BURDEN: ANYTHING CAN HAPPEN ON EARTH—EVEN INSANITY

Now, another thing, I say. That, verily, it is a direful thing for the mind of him who has suffered from a grievous calamity to become insane, that, in fact, the powers causing insanity are immune from everything on this earth, and has the power to end the days of man, and that it may be caused by the lack or falling away of the mind.

That, more than this, do thou know it, my offspring, whom I have been wont to hold in my bosom, that the Three Brothers have now perfected their preparations, and now, furthermore, let them say it, that "We forbid thee in this matter. We caution thee, let not the minds of thy people become insane from grief; let the matter, instead, remain in perfect peace" (I say).

Thus, furthermore, let it be that for one poor short day thou mayest continue to think in contentment and peace, thou noble ruler, my offspring, whom I have been wont to hold in my bosom (I say).

In this manner, then, may it be, let the Three Brothers, so denominated ever since they were in the prime of their affairs, do it thus.

Now more than this, do thou know it, this one (*indicating*), my offspring, thou noble ruler, whom I have been wont to hold in my bosom, the Word (attesting wampum string) of thy *Adon'ni* is on its way hence to thee (I say). (Fig. 14.)[11]

THE FOURTEENTH ARTICLE OR BURDEN: THE TORCH OF NOTIFICATION[12]

Now, another thing I say. That when our grandsires who have departed this life, conjoined their affairs, they made a decree, saying: "Here we place two rods together, and therein, moreover, we fix a torch between the two rods. We, every one of our council fires, own this torch equally. Moreover, this torch shall be one of the essential things wherever be the place in which a direful thing may occur" (I say).[13]

[10] Hewitt's personal copy of his 1916 paper, in the Holmes Anniversary Volume, bears a penciled insertion "*Hoyā'ne'*," the Federal Chief, on p. 177 after line 3; this agrees with Chief Abram Charles' set of Requickening strings, of which XIII is Hoyā'ne' [the Chief]; while in the present text this is the fifteenth burden.—W.N.F.

[11] In the Cayuga set of Requickening strings which Abram Charles conveyed to Hewitt, this string is numbered XIV.—W.N.F.

[12] No. XV in Chief Charles' set; and in Hewitt's summary papers *Ethnological Studies among the Iroquois Indians* (Exploration and Field Work of the Smithsonian Institution, 1926: 246. 1927; and *"The League of Nations" of the Iroquois in Canada* (*Ibid.*, 1929: 204. 1930).

[13] Torches were formerly made by binding shell bark hickory rind around the end of a stick. A supply of these was always kept in the longhouse of assembly.—S. GIBSON.

If it so be, that one will see what may cause them death then that person shall take this torch and that person shall indeed start at once through the Lodge of the League, and in such manner shall he go that in the shortest possible time that person shall pass the Lodge of the League, and all the council fires shall have notice of the message, even that very night.

And it shall be done in such manner that there shall be no traces—no "forms—of lying down on the path." Now, more than this, the Three Brothers say, "Now we again put the torch between the two poles, and we also now put back there the small pouch of an (unknown) animal containing the Short [Purple String of Notification (Hewitt, Ethnological Studies . . . , 246)] wampum which we equally own" (I say).

Thus, furthermore, let it be, that for one poor short day, thou noble ruler, my offspring, thou mayest continue to think in contentment.

In this manner, then, perhaps, let them do it, the Three Brothers, so denominated while they were in the prime of their affairs.

Now, furthermore, do thou know it, thou noble one, my offspring, their Word (wampum string) is going hence to thee (I say).

These are the number of words, then, that the Three Brothers desired to address to thee, this one (*indicating*), my offspring, thou noble ruler, whom I have been wont to hold in my bosom. Now more than this, we do expect that all our words, thus addressed to thee, have come to pass, for thy peace and welfare.

Now, more than this, do thou know it, this one (*indicating*), thou *yaa'nehr*, my offspring, thou noble ruler, whom I have been wont to hold in my bosom, the Word (attesting wampum string) of thy Adon'ni is on its way hence to thee (I say).

THE FIFTEENTH ARTICLE OR BURDEN: THE APPEAL FOR THE CANDIDATE

Now, another matter let us consider this day. Thou must give strict attention to the words, thou *yaa'nehr*, my offspring, whom I have been wont to hold in my bosom.

Now, again I have set in order all thy affairs. Now furthermore, the Three Brothers have been noticing that the mat whereon thy co-worker was wont to rest has been caused to be vacant (I say).

Moreover, that they upon whom our forefathers depended for wisdom and guidance, in uniting their affairs, decreed, saying: "It matters not, indeed, on which side of the Council Fire there is a loss, it shall be possible, and it shall be urgent that they shall again set the candidate's face fronting the people; that they shall again raise him up (requicken), that they shall again name him, and that also he shall again stand upright in front of the people (I say)."

More than this, thou *yaa'nehr*, my offspring, thou noble ruler, the Three Brothers are on the ceremonial path; and so now let them say it, "Do thou now point out to us the one who shall be our co-worker" (I say).

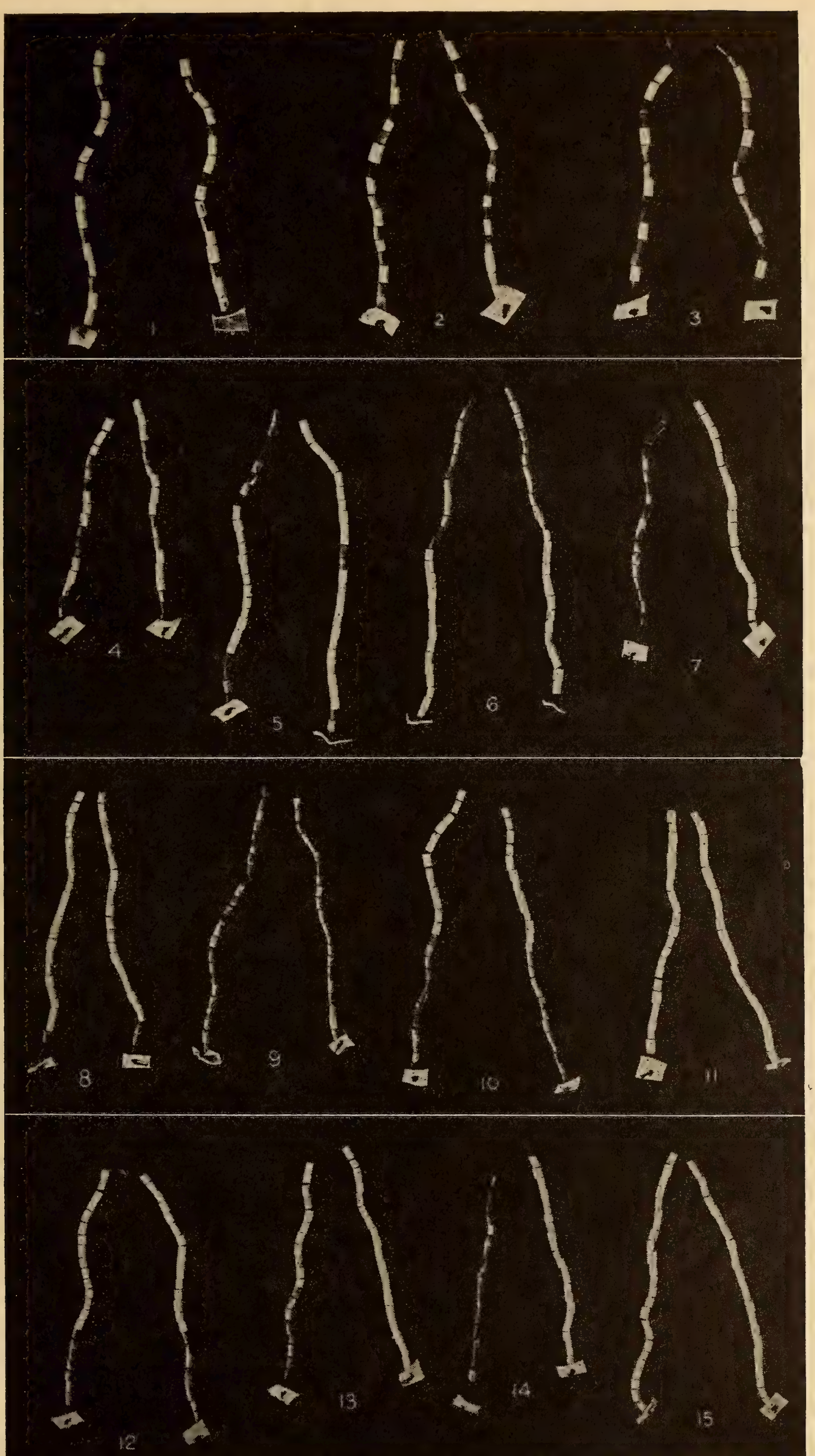
Thus, now, thou *yaa'nehr*, my offspring, thou noble ruler, do thou know it; we Three Brothers have completed the ceremony.

Now, then lastly, that which gave us notice of this matter (a short string of black wampum) now goes hence to thee.

Also, do thou know it, thou *yaa'nehr* (Federal Chief), my offspring, thou noble ruler, that immediately now the Three Brothers, shall rise to depart homeward; and there, moreover, at the forest's edge, they will lay down their pouches for the night (I say).

There it is.

The Requickening Strings of Wampum of the Cayuga Nation (collected in 1919 from Chief Abram Charles, Six Nations Reserve, Canada, by J. N. B. Hewitt): Fig. 1.—*oga'hthri*, Tears, or one's eyes: Seeing. Fig. 2.—*hahondaga'ronde'*, His ear openings: Hearing. Fig. 3.—*dehanya'doo'gen*, One's throat is full: Speaking. Fig. 4.—*eya'dagon'wah*, Within his breast. Fig. 5.—*ondyeendak'khwa'*, One's customary resting place: The bloody husk-mat bed. Fig. 6.—*dayo''gaah*, The deep darkness of grief. Fig. 7.—*wa'hodronhya'hdoon*, One has lost sight of the Sky. Fig. 8.—*wa'hohdrahgwa'hdoon*, One has lost the Sun. Fig. 9.—*heyo'daägwaiin'da'*, At the Grave. Fig. 10.—*Dewa'hshen niyoi'hwaks*, Twenty is the cost—for homicide. Fig. 11.—*deyonshdjisdadon'hkwa'h*, At the hearth of the home: The Council Fire. Fig. 12.—*Onthonwi'sas; hohsken'engeh'da'*, Woman and Warrior: The Creator's Assistants. Fig. 13.—*Hoyaa'neh*, the Federal Chief. Fig. 14.—*hya'hden de'aonhwendjana'goo'was*, Anything can happen on earth—even suicide or insanity. Fig. 15.—*gahashra'heen'*, The Torch.



Figs. 1–15.—For explanation, see opposite page.

EXPLANATORY NOTES ON THE IROQUOIS CONFEDERACY AND ITS SOCIAL ORGANIZATION

Deganawi'dah, founder of the League.—The League, or Confederation, of Five Iroquois Tribes, had already been formed by the year 1570 A.D. This accomplishment derived chiefly from the unwearied labors during several decades of one man who was named *Deganawi'dah* from a dream which his mother experienced during her pregnancy. Deganawi'dah was, tradition informs us, born of a virgin mother, and his paternity, like that of all other great national heroes, came from Heaven; however, it tells nothing of his nationality or tribal descent. It sufficed Iroquois tradition that Deganawi'dah was a divine man. Therefore, no ethnic brood (band) or land claimed him as a son. During the years of his great work he consistently declined chiefship or official position, but in imitation of his refusal to assume an official title, the class of Pine Tree Chiefs—Chiefs of Merit—was later instituted. The traditional annals put his place of birth in the immediate vicinity of Bay of Quinte, in northeastern Lake Ontario, which at his time was in Huron territory.

Authentic tradition relates that the mother and grandmother of Deganawi'dah were members of a moribund *uterine family* (*Ohwachira*), which, therefore, lacked sufficient status in the community to be thought worthy of having their clan membership mentioned, and so tradition is silent as to their clan.

The mother of Deganawi'dah was "born with a caul." At that time the belief was popular among her people that this was a good omen. The Giver of Life destined such a child to grow in the knowledge of esoteric doctrine and spiritual powers through proper discipline and teaching by close blood relations. To accomplish this divine purpose, they held the future mother of Deganawi'dah closely concealed from birth to maidenhood, keeping her strictly hidden from all kin and other persons, except her own mother who served as guardian. The guardian must not only maintain a ceaseless vigil over the ward by night and day, but also teach the candidate the esoteric wisdom belonging particularly to her own uterine family, ever emphasizing the pupil's duty to attend carefully the words and cautions whispered by surrounding spirits and the Giver of Life.

In view of the tabus and confinement attending the education and rearing of such a child to puberty, and particularly a girl, it is not strange [Hewitt reasoned] that she should be thought worthy to receive life directly from the Giver of all life and to become a mother without natural intercourse. So in tradition she became the virgin mother of her first born; and from this, too, is derived her name, *Djigonsahsée'*, "she whose face is doubly pure"—implying physical as well as moral beauty and rectitude.[14]

The foresight, unwearied efforts, broad statesmanship, and the disinterested love of mankind, which made of Deganawi'dah a remarkable personality, primarily shaped and later perfected the peculiar organic institutions on which the League of the Five Iroquois tribes rested. [Despite Hewitt's enthusiasm for the great man theory of history, the editor feels that the League rested rather on basic principles of Iroquois social organization already operative in the tribes which confederated.] These were the Mohawk, Onondaga, and Seneca tribes of the one moiety, which was known as the Male or Father group (moiety), and the

[14] Djigonhsa'sen', *is* "fat face," according to S. Gibson, and it means one of great influence.—W.N.F.

The name which the poet annalists of Iroquois tradition bestowed on the mother of Deganawi'dah was *Djigonsahsee'e'*, the literal significance of which is "a face, doubly pure and spotless"; i.e., "a face which is new, pure, and spotless in a superlative degree," exceeding in these qualities and attributes those of a new born baby, because she had given birth to a son whose life she had received from the Creator of life.

[In spite of a uniform contrary tradition . . . (Hewitt) . . . in 1931 was successful in recovering the authentic tradition, showing conclusively what for some years he had suspected.] Undiscriminating popular tradition had unwittingly displaced the real mother of Deganawi'dah by an unhistorical figure named Djigonhsa''sen', "the wild cat," or, literally, "fat face." This name was loosely applied by Iroquois speakers to the Neutral and Erie Nations, and the early French explorers called the latter the "Cat Nation." This, then, was a tribal name, and there is no evidence that it was also a personal name except as used by false tradition. This fortunate recovery of the true name of Deganawi'dah's mother and of the attendant circumstances has clarified a number of contradictory incidents and corrected some serious incongruities in Deganawi'dah's traditional biography, which is the origin legend of the founding of the Iroquois League.—J.N.B.H.

See also Hewitt, *Field studies among the Iroquois tribes.* Explorations and Field Work of the Smithsonian Institution, 1931; 178. 1932.

Oneida and Cayuga, of the other moiety, constituting the Female or Mother group. [The Father group is, according to Hardy Gibson, also known as the Three Brothers; while the Four Brothers side comprises Oneida and Cayuga, possessing the right to install chiefs (the hai'hai' privilege), and the Tuscarora (admitted to the League before 1722), and the Tutelo and Delaware, who joined the League afterward.]

Moiety or dual division.—The remarkable and ineffaceable dualism that characterizes the functioning of Iroquois social institutions rests [Hewitt thought] on certain cosmic and biologic ideas and concepts implicit in their beliefs regarding the manner in which the universe of "Matter and Mind" came into being and by which it exists. Failure to recognize this obvious but persistent duality in Iroquois social institutions led some writers [notably Goldenweiser and Lowie] needlessly to use the phrases "in control" and "tripartite arrangement" when attempting to explain the significance of the positions which certain clans take in tribal councils, and by the Onondaga tribe in the Council of the Iroquois League; however, in these councils the positions occupied by certain clans and by the Onondaga tribe does not infringe or militate against this higher duality.[15]

The longhouse as social symbol.—To understand the meaning and purpose of the great memorial service to condole dead League officials and to install new candidates to office some explanation of the social and political organization of the Iroquois tribes and their confederacy is necessary.

Near the last quarter of the sixteenth century, five linguistically cognate tribes—the Mohawk, Oneida, Onondaga, Cayuga, and most of the Seneca—had united in a confederacy that they called *Ganonsyon'ni'*, "the completed longhouse," and that English historians call the League of the Iroquois. At the time of confederacy these five tribes as independent states occupied central New York between Schenectady and the Genesee River. Subsequently, when the unincorporated factions of the Seneca were admitted into the League, it was done on condition that their two chief warriors should be made members of the federal council with certain special rites and duties. In the face of bitter opposition, the astute prophets and statesmen, Deganawi'dah and Hiawatha, for the latter had suffered personal discomfort from sorcery, blood feud, and cannibalism, accomplished a peaceful reformation and social revolution in the social forms, scope, and purposes of government among the peoples that formed the five tribes. These changes were at once fundamental and far-reaching in immediate results and influenced subsequent history of neighboring tribes and colonial ventures in northeastern America.

Deganawi'dah at his mother's suggestion had sought the cooperation of a reputed cannibal, who resorted upon occasion to this practice which although current was rather the exception among his people. After a lengthy conference, Deganawi'dah aroused in him a latent love for mankind, causing him to resolve firmly to renounce his former way of life and to adopt Deganawi'dah's principles of reason, righteousness, law, and peace. Tradition says that Deganawi'dah named him Hiawatha. The latter from then on became the disciple and collaborator of Deganawi'dah in the difficult task of organizing the League. Strangely enough, tradition makes both of these heroes master sorcerers, a reputation they received from their fellows because they achieved noteworthy success against insidious opposition and particularly because they overcame the power and bitter antagonism of Dehadoda'ho, that master sorcerer and man-eater of the Onondaga.

The biological analogy of society.—[Hewitt

[15] Goldenweiser's reports on Iroquois field work remain the only brilliant expositions of Iroquois social organization, although the bulk of his field notes remain unpublished in the editor's hands. Inasmuch as Hewitt could not bring his materials to the point of publication, his criticism of later students is neither fair nor entirely accurate, as Goldenweiser blueprinted a spatial arrangement that had existence in practice (Goldenweiser. *On Iroquois Work, 1912*, Canada Department of Mines, Summary Report, Geological Survey, 1912, 464–475, Ottawa, 1914, and *On Iroquois Work, 1913–14*, *Ibid.*, 1913, 365–372, Ottawa, 1914.)

I find an unpublished squib by Hewitt in criticism of Robert H. Lowie's article *Queries* (Amer. Anthrop., n.s., **36**: 324–335. 1934). He resented as superficial Lowie's statement that "the Iroquois League councils formed a tripartite instead of the otherwise customary dual grouping . . ." The Iroquois League council was organized originally into two brotherhoods, the first, of three tribes: Mohawk, Seneca, and Onondaga; and the second, of two tribes: Oneida and Cayuga. The Onondaga, being the firekeepers, did not sit with their brothers the Mohawk and Seneca but sat apart from both as judges of the correctness of the proceedings and as such were prohibited from discussing questions before the council. The Onondaga were nevertheless included in the expression "We three brothers."—W.N.F.

thought that tribal society rested on certain fundamental organic analogies.] A fundamental clan and tribal dualism, already alluded to, consisted in the symbolic recognition of sexual principles, male and female, which lay at the very bottom of Iroquois civil and religious institutions. This formal acknowledgment of the complementary character of the interrelation of the sexes was first wrought into the structure of the tribe. [Hewitt attributes this to the prevailing inhibition of sexual relations between certain maternal lineages or *Ohwachira* which he calls *uterine families.*] In turn this ban on promiscuity may have determined the grouping of the maternal families into clans. Hence, arose the rule that clan members must avoid sex relations among themselves. And, therefore, the maternal families, if more than one in number, which composed a clan, were sisters to each other.

This symbolization of the sexes in the tribal and federal institutions of the Iroquois was designed to secure and promote the fertility of the community; and it seems to have been the effect of a naïve trust in the esoteric power of symbols.[16]

Family.—[The simplest unit of Iroquois society is the "fireside," or the primary family of husband and wife and their children who live with them.]

Lineage.—[Stemming from the fireside family by virtue of common residence in the longhouse of the matriarch is the household of fact and legal fiction composed of a lineage of persons tracing descent from a common mother and forming an exogamic incest group called the *Ohwachira*, the maternal or uterine family. This is the primary unit of Iroquois government. In time it might occupy several longhouses in several villages.]

Clan.—[An Iroquois clan is composed of two or more maternal families who behave as if the members of each generation were siblings, or as if they constituted a single maternal family. Hewitt calls these sisterhood relationships. Actually the two families may be derived from a single lineage, but frequently the links connecting collateral lines have been forgotten; or long ago a woman was adopted whose decendents in the female line may not know that they were not true kindred of their clansmen. The Iroquois clan, therefore, is a legal fiction, but the maternal family is a physical reality. Iroquois constantly confuse the two. As time passes family lines are forgotten but clanship is remembered so that in a given generation individual behavior is strongly colored by membership in a clan.]

Anciently, the uterine or maternal families were units in marrying. Big bear married Small bear, etc. Later people married only within the tribe, i.e., Cayugas were reluctant to marry Onondagas, etc. Now they marry between tribes. I think that after the formation of the League marriage was across the fire. My father, Chief John A. Gibson, said that it was preferable to marry in the opposite moiety rather than on the "same side of the fire."—SIMEON GIBSON.

Phratry.—One or more clans constituted a sisterhood (phratry) of clans, and two such sisterhoods (phratries) of clans composed an Iroquoian tribe. Two similar sisterhoods (tribal phratries) constituted the League of the Iroquois. The first sisterhood (tribal phratry)—the Mohawk, Onondaga, and the Seneca tribes—represented symbolically the Male principle or the Father side; and the second sisterhood (tribal phratry), the Oneida and Cayuga tribes, represented the Female principle in nature or the Mother side. [This is clearly a moiety system with reciprocity between the dual divisions as the keynote of its functioning.]

It is important to remember when reading the rituals of the Condolence Council that the foregoing dualism is embodied in the terms of address employed between participating tribal phratries. One phratry of tribes condoles the other—the side which has lost one or more officers; it intones the prescribed rituals to comfort and restore the minds of the mourners. It does this in the name of the father's clansmen, *Adon'ni* "the sires," of the mourners who are addressed as if they were "our brother's children, our offspring."

Clan, tribe, and chief.—Three is the smallest number of clans found in Iroquois tribal organization. The Mohawk and Oneida each have this number. Each of these clans has three

[16] The editor feels, in view of the character of clan organization among the Muskhogean peoples of the Southeast and among the Siouan and Algonquian peoples of the upper Mississippi and the Great Lakes region, which like that of the Iroquois was given to classificatory kinship system, unilateral descent, and sibs, that Hewitt's view of Iroquois clan organization is essentially unhistorical. One might attribute a "naïve trust in the esoteric power of symbols, a form of belief so characteristic of inchoate mentation . . . " to Hewitt and not to the Iroquois.—W.N.F.

ohwachira, maternal families each bearing a distinctive name and respectively owning a male chiefship title, which is held in trust by the matron of the family, and the incumbent to the title represents the family in both the tribal and federal councils in the transaction of public business.[17] *Yaa'nehr* is the native Mohawk dialectic form for the federal chiefship status. Further, the Mohawk and Oneida tribes, respectively, having three clans each, have nine chiefships in the council meetings held by males, and nine trusteeships held by females. [Hewitt says that attendance at councils is optional with female officers, but it would seem that within recent years matrons seldom attended councils. According to Hardy Gibson, the matron does not come to the council when she has someone to represent her there. However, the chiefs may invite the matrons to attend when a special issue involving the welfare of the whole tribe such as the sale of land is being discussed.] Now the maternal families in the same clan regarded one another as "sisters' (siblings), but they do not on that account interfere with one another's affairs. The joint action of the three maternal families constitutes the action of the clan they represent. Defined in terms of representation and jurisdiction, Iroquois chiefs, both male incumbents and female trustees, were not clan officers strictly speaking. Rather these officers represent the maternal families which own their titles and which, for cause, could recall them from their official positions.

The three clans of the Mohawk and Oneida tribes were grouped in each tribe into two complementary kinship units or moieties, the one group representing the male or father principle, and the other, the female or mother principle in nature. Each of these groups is customarily called a sisterhood (phratry) of clans.

Remember that the Bear clan in these two tribes is actually constituted of three Bear *Ohwachira* (maternal families), which are the Adult Bear lineage, the Weanling Bear, and the Nursing Bear lineages, so that, strictly speaking, the so-called "Bear clan" is really a sisterhood (phratry) of Bear maternal families; and the same statement is true of the Turtle and Wolf clans, for they are constituted of three kinds of animals bearing the name.

Members of the clans or of the tribal sisterhoods (phratries) of the male or father side of the symbolic council fire address the members of clans or tribal sisterhoods (phratries) of the female or mother side across the fire as "cousins." Reciprocally, members of the clans or tribal sisterhoods (phratries) on the female or mother side of the fire likewise claim "cousinship" with the members of the father side.

There is, however, a higher form of ritualistic address which is special and peculiar to one or the other of the two basic organic units (moieties), i.e., to the male or father group of clans or tribes, or to the female or mother group of clans or tribes. As defined above, speakers of the mother groups (moieties) address the opposite moiety, and the father groups, as "my father's clansmen" (agadonihee'nun' (Oa.)) or (agadoni'shun' (Oe. and C.)) or "our father's clansmen." Conversely, the speakers for the father groups address the mother groups as "my offspring" (gunya'daa'wen' (Oa.)) (used by M.-Oa.-S., Three Brothers for Four Brothers) or "our offspring," because in the "fireside" family of husband and wife, the children belong to the mother side of the lodge, and as this is the symbolic mother-group—the mother-clan group or tribe group (moiety)—it is also the "offspring" side or group (moiety); but this side (moiety) may be also addressed as the "Woman (gono'ha' (Oa.)) or the "Womanhood" (gontonwi'sas (Oa.)), as may be seen in the words of the Farewell Chant in the memorial ceremony of condolence and installation.

It is thus seen that the fundamental dualism in the organic structure of the Iroquois League is based on an analogy with nature and consists of the concepts: male sex principle, father, or fatherhood in nature, on the one hand; and the female sex principle, mother, or motherhood in nature, on the other. Ceremonial obligations between the two moieties are conceived as reciprocal or complementary functions.

Moreover, the rule tracing descent of rights, duties, membership in a family, succession to office, and property, through the female line, is

[17] Hewitt's original manuscript reads, "a male chiefship title and a female chiefship title . . . ," which is correct insofar as the statuses occupied by male federal chief and matron of the appointing family receive masculine and feminine forms of the same term, but all the evidence that I have been able to gather indicates that the clan and family were represented in council by a male chief, the holder of the title. Behind him at home, his mother or sister or mother's sister, as the case might be, literally held the short string of office, the wampum emblematic of his status.—W.N.F.

not in the least affected by the device of this symbolic duality or moiety system in tribal organization. The men of the half representing the male or father principle have rights or obligations which the men of the group representing the female or mother principle do not exercise or possess. Within the League council authority is equal although certain offices carry specific responsibilities. In rank and prerogatives the federal chiefs of the League, both male incumbents and female trustees, were in all respects coequal; special functions in the council chamber did not add to their rank, authority, or to their jurisdiction.

Clan apportionment.—The Mohawk tribe had three clans: Turtle, Wolf, and Bear. The first two, Turtle and Wolf, formed a phratry [sisterhood, according to Hewitt], addressing each other as "brothers" (sisters); and the Bear clan alone comprised the other moiety, being composed of three maternal families (eponymic Ohwachira). In the council chamber the three Turtle chiefs acted as "firekeepers" (or judges); and as such, they did not discuss the subject matter before the tribal council. The Wolf and Turtle clans addressed the Bear clan as "cousin," and reciprocally. In considering an issue, the three Wolf chiefs first discussed the question before the Council, and having reached a decision they passed the question over the symbolic council fire to the chiefs of the Bear clan, who then discussed it. When the latter had reached a decision, the two decisions, agreeing or conflicting, were referred to the firekeepers (judges), the Turtle chiefs, who in case the two decisions agreed confirmed them; but in the event of a disagreement between them they referred the matter back to the chiefs of the Wolf and the Bear clans, with suggestions as to how the two opinions might be reconciled.

The Oneida tribe had the same three clans, but enumerated them somewhat differently: Wolf, Turtle, and Bear. Wolf and Bear formed a phratry, and again Bear alone comprised the other moiety, again being composed of three maternal families, each represented by a federal male chief, appointed by a matron. But in the Oneida council the Wolf chiefs were the firekeepers (judges), and the council procedure was the same as with the Mohawk.[18]

Acting as judges in the council chamber in no wise gave the clan or tribe, as the Onondaga in the council of the League, who furnished the firekeepers any measure of "control,"[19] nor did it effect a rearrangement of the clan or tribal organization.

[For the Seneca tribe, Hewitt had recorded names of nine clans: Wolf, Bear, Beaver, Turtle; Hawk, Sandpiper (variously called Snipe, Plover, and Killdeer), Deer, Doe(?), and Heron (sometimes called Swan).[20] Only five of these had an unequal representation in the federal council of the League, as follows: Sandpiper (three chiefs), Turtle (two), Hawk, Wolf, and Bear (one each).]

Names of nine Onondaga clans were recorded: Wolf, Turtle (Tortoise), Bear, Deer, Eel, Beaver, Hawk, Sandpiper (Plover, or Snipe), and Pigeon Hawk. The Wolf, Bear, Sandpiper, Hawk, and Pigeon Hawk clans each had only one Federal Chiefship; but the Beaver, Turtle, and Eel clans each had two Federal Chiefships, while the Deer clan had three. The reason for this disparity in representation in the Federal council is still unclear.

[For some reason, Hewitt did not list the Cayuga clans and the apportionment of chiefs among them, but his notes include the following: Ten Cayuga titles were distributed among Bear clan (three), Hawk (one), Turtle (two), Long-legged Wolf (one), Wolf (one), Large Plover (one), Plover (one) (Seth Newhouse, 1917). A list by Chief Abram Charles is in substantial agreement. Here again several clans were without representatives.]

Iroquois woman.—A further fact must be kept in view. Every male Federal Chief (*yaa'*-

[18] See Fenton, *Problems arising from the historic northeastern position of the Iroquois.* Smithsonian Misc. Coll. **100**: 204–205, 217–218. 1940.

[19] Dr. Alexander Goldenweiser had used this convenient phrase, and apparently Hewitt felt that its use implied administrative authority.—W.N.F.

[20] Lewis Morgan (*The League of the . . . Iroquois,* New York, 1901) gives, for the Seneca: Bear, Wolf, Beaver, Turtle; Deer, Snipe, Heron, Hawk—which is still true of the Seneca nation in western New York. The Eel clan is sometimes added to the latter moiety. Goldenweiser, who investigated this matter thoroughly at Six Nations Reserve (Canada), lists the *old* Seneca alignment (before confederation): Turtle, Wolf, Bear, and *Ball;* Hawk, Deer, *Duck,* Snipe, and Eel. And the *new* alignment, which differs only in the latter moiety, is: Deer, Hawk, Sand Snipe, Big-snipe, and (Duck). The "new" arrangment (after confederation) represents the grouping of the clans on ceremonial occasions; and it is not known to what side the Eel clan of the Seneca belonged after Confederacy (Goldenweiser, Field Notes MS., vol. 5, p. 29.)—W.N.F.

nehr) represented a maternal family (Ohwachira) which owned his official title and which was presided over by a matron or woman Federal Chief (*Goyanehrgoo'nah*) who had the right, and the imposed duty to exercise this right in the event of an emergency, to occupy a seat in the Federal Council. Moreover, the woman Federal Chief with the advice and consent of the Federal Chief locally administers the affairs of the maternal family she heads.

Language usage in designating the woman Federal Chief is indicative of her preeminent position and of the prerogatives of this unique official. [In theory, at least, she had dominance over the male chief, in contrast with our own society in which the reverse may be true.]

The native Iroquois for the title of the male Federal Chief in the Mohawk and other rhotacist dialects is *royaa'nehr*, the noun stem being *-yaanehr*, i.e., "he (is) a Federal Chief." In the non-rhotacist dialects, such as Onondaga and Seneca, this term becomes *hoyaa'neh*, the noun stem being *-yaaneh;* [to this stem, which means fundamentally "agent of law, welfare, etc.," Hewitt gave this rather elaborate interpretation]: "having the capacity or competence of producing or effecting what is good, useful, and promotive of welfare." Since the League of the Iroquois aimed through its institutions at achieving the well-being of all persons subject to its jurisdiction, this term became the fitting designation of League officials, as well as of its distinctive laws and principles, and of the League itself.

When this expressive term is applied to a woman officer of the League, there is suffixed to it the attributive *-koo'wah* (Mohawk), and *-goo'nah* (Onondaga). This suffix means "great" or "grand." Hence the full title *koyaanehrkoo'wah* (M.), and *goyaanehgoo'nah* (Oa.) accordingly means "she is a great" or "grand Federal Chief" [or simply the "Matron" or "Clan mother" of modern reservation parlance]. Good usage restricts this form of the title, though not quite exclusively, to the woman Federal Chief, whose position was above that of her male representative in the council because, as custodian of the chiefship title in her maternal family, she had the power to appoint and recall him should his conduct become unworthy of his office.

The symbolic council fire.—In every place of public assembly there is, or at least there is assumed to be, a hearth or fire-altar, which was placed at some distance from either end of the song-bench, which ordinarily occupies the central floor or space as in Iroquois longhouses today, or simply one fire was conceived as resting in the center of the meeting place, as formerly in the Six Nations Council House at Ohsweken. The benches of the chiefs were ranged about this fire, and issues of debate among the tribes were thought of as being "handed" or "thrown" or merely "going" across the fire, according to the temper of the debate. [The "old council" at Ohsweken, i.e., before 1924, was ranged in this manner: The Mohawks and Senecas, being the parent group, sat east of the fire, the former to the north, while the Oneidas and Cayugas sat across the fire on the west, with the Oneidas to the north; and the Onondaga chiefs as firekeepers sat north of the fire. In later times, His Majesty's agent sat above them on a dais, and he was provided with an interpreter and clerk, whose importance grew with the passing of the years.]

PALEONTOLOGY.—Cytidocrinus, *new name for* Cyrtocrinus *Kirk*.[1]

EDWIN KIRK, Geological Survey, United States Department of the Interior.

In this JOURNAL (1943, p. 263) I proposed the new genus *Cyrtocrinus* for a Mississippian crinoid formerly referred to *Steganocrinus.* I find that this generic name has been preoccupied by Jaekel (1891, p. 602) for a Mesozoic crinoid. I am therefore proposing the name *Cytidocrinus* to replace *Cyrtocrinus* Kirk *non* Jaekel. The genotype is *Actinocrinus sculptus* Hall, which will therefore read *Cytidocrinus sculptus* (Hall).

[1] Published by permission of the Director, U. S. Geological Survey. Received January 8, 1944.

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ZOOLOGY.—*Notes on the trematode subfamily Loimoinae (Monogenea), with a description of a new genus.*[1] HAROLD W. MANTER, University of Nebraska. (Communicated by WALDO L. SCHMITT.)

The subfamily Loimoinae was named by Price (1936) for a peculiar monogenetic trematode, *Loimos salpinggoides* MacCallum, 1917, from the gills of a dusky shark, *Carcharias obscurus* (Lesueur), at Woods Hole, Mass. Price (1938) redescribed this trematode, correcting several errors made by MacCallum. Manter (1938) described *Tricotyle scoliodoni* from a shark, *Scoliodon terrae-novae* (Richardson), from Beaufort, N. C. He noted some similarities between *Tricotyle* and *Loimos*. The redescription of *Loimos* by Price increased these similarities.

Among specimens of trematodes collected by the late Dr. C. B. Wilson and sent to me for identification was a monogenetic species collected from the gills of the hammerhead shark, *Sphyrna zygaena* (Linnaeus), at Montego Bay, Jamaica, in 1910. This trematode proved to be related to *Loimos* and *Tricotyle* and led to a comparative study of type and paratype specimens of all three species. This study revealed the need for additions to the descriptions of both *Loimos* and *Tricotyle* and indicated the reduction of *Tricotyle* to synonymy with *Loimos* and the erection of a new, closely related genus. The author is indebted to the National Museum (more particularly to Dr. Waldo L. Schmitt and Dr. Paul Bartsch) for loan of original material, and to Dr. Emmett W. Price, of the Bureau of Animal Industry, for several suggestions.

The following additions can be made to the description of *Loimos salpinggoides:* (1) A vagina is present, extending forward from the ootype slightly to the left of midline, parallel or almost parallel with the uterus and cirrus, and opening on the ventral surface to the left of midline a short distance posterior to the male pore (Fig. 5). It is less glandular, thinner walled, and much less conspicuous than in *Tricotyle*. (2) The number of testes seems to be 8 or 9; these are rounded, tandem, and pressed very close together but separated by membranes. (3) An anterior portion of the pharynx with circular muscles is distinctly demarked from the larger posterior portion with the characteristic thick muscular bands. Some indication of this anterior sphincter is seen in MacCallum's and Price's figures. (4) On the dorsal surface of the body near the posterior end and dorsal to the haptor are two pairs of transverse (or diagonally transverse) cuticular folds or ridges with sharp edges (Fig. 6). High magnification reveals that the edges of these folds (Fig. 7) are provided with very small sharp papillae or spines (like a file). The folds are fairly conspicuous, appearing (in the strongly pressed specimens) as diagonal lines. They extend inward from the sides of the body but do not quite reach the midline. These sharp-edged ridges are the same structures as the two dorsal, shallow cup-shaped structures described for *Tricotyle*. Since the *L. salpinggoides* specimens were killed under excessive pressure, the ridges are probably normally somewhat elevated as described for *Tricotyle*.

In view of the above conditions, it seems probable that *Loimos* and *Tricotyle* represent a single genus. *Tricotyle* Manter, 1938, should be considered a synonym of *Loimos* MacCallum, 1917. A revised diagnosis of the genus will be given below. *Loimos salpinggoides* MacCallum, 1917, and *Loimos scoliodoni* (Manter, 1938), n. comb., can be distinguished in that *L. salpinggoides* possesses two pairs of suckers (rather than one pair) in the anterior haptor; is smaller in size; and has a much less conspicuous (thin-walled, less glandular) vagina, relatively longer cirrus, and more numerous, more rounded testes. The actual, normal condition of the ovary in *L. salpinggoides* is still not clear. The organ seems to be rather compact, but its cells are well scattered, its outline rather uncertain, so that it may actually be essentially like the irregularly shaped ovary of *L. scoliodoni*. In *L. salpinggoides* the shell gland is more conspicu-

[1] Studies from the Zoological Laboratory, University of Nebraska, No. 217. Received December 4, 1943.

ous than the prostate gland (cells of which are immediately anterior to the shell gland), while in *L. scoliodoni* the prostate gland is the more conspicuous. A shell gland, however, is definitely present in *L. scoliodoni* although not indicated in the original description.

The third species (from the hammerhead shark) is clearly related to *Loimos* but is probably sufficiently distinct to warrant a separate genus. The following description is based on about 25 specimens in rather poor condition. The measurements are from 5 of the more favorable specimens.

Loimosina wilsoni, n. gen., n. sp.[2]

Figs. 1–4

Host.—*Sphyrna zygaena* (Linnaeus).

Location.—Gills.

Locality.—Montego Bay, Jamaica.

Specimens.—U.S.N.M. Helminthological Coll. 36861 (type and paratypes).

Description.—Muscular parasites of this type can exhibit a great range in body size and proportions depending on degree of contraction. The present specimens were apparently not pressed at all in killing.

Size 0.875 to 2.389 mm by 0.750 to 0.772 mm, greatest width near midbody. Anterior haptor 0.140 to 0.190 mm in transverse diameter. In the dorsal wall of this haptor are three pairs of muscular loculi opening ventrally or ventrolaterally (Fig. 2). The median pair of loculi is larger than the others. Posterior haptor 0.345 to 0.517 mm in transverse diameter, bearing one pair of large hooks (Fig. 3) and a number of very minute hooks. There are very inconspicuous, more or less radially arranged bands of transverse fibers within the haptor. Large hooks (two were measured), 0.046 to 0.053 mm long; outer root long and slender; inner root short and wide.

Mouth at the base of a slight posterior extension of the anterior haptor. Pharynx 0.172 to 0.225 mm long by 0.120 to 0.172 mm wide, transversely ribbed; with very weak, inconspicuous anterior sphincter (not visible in some specimens). Caeca unbranched, bowing outward from base of pharynx, then extending to near the posterior end of the body where they end blindly. Testis large, single, very deeply multilobed. These lobes seem to be connected at least medianly so that the testis is considered as single. The male pore is a median or submedian, transverse slit ventral to the posterior portion of the pharynx. A large, ovoid, relatively wide, cirrus-sac-like organ extends dorsoposteriorly from the pore and encloses a lightly fibrous tissue (probably the tall, thin-walled cells described for *L. scoliodoni*) and, in its base, a small spherical, internal seminal vesicle. While this sac appears to be a cirrus sac, I interpret it to be homologous with the "ejaculatory bulb" described for *L. salpinggoides*. The cirrus is rudimentary, consisting of a very short, very thinly chitinized tube near the male pore. Whether this cirrus is enclosed within the ejaculatory bulb or is external to the tip of the bulb (as in *Loimos*) could not be determined. The external seminal vesicle extends anteriorly along one side of the ejaculatory bulb, crosses to the other side dorsal to anterior portion of the bulb, then extends posteriorly to the base of the bulb. Prostatic gland external to bulb, large, bilobed, one lobe on each side at base of pharynx.

Ovary immediately pretesticular, tubular, and branched. Mehlis's or shell gland small, immediately preovarian. Vagina conspicuous, with thick glandular wall, extending diagonally to the left approximately opposite ejaculatory bulb; vaginal pore large, ventral, midway between midline and left edge of body, about midway between base of pharynx and the ovary, sometimes opposite base of pharynx. Vitellaria of numerous follicles filling sides of body from near anterior end of pharynx to near posterior end of body, dorsal and ventral to caeca, crowding the testis laterally, confluent posterior to testis but in this region they are chiefly dorsal. Transverse vitelline ducts at anterior edge of ovary. Uterus short; uterine pore inconspicuous, round or ovoid, immediately posterior to male pore. An egg, perhaps not fully formed, 54μ by 48μ, occurred in only one specimen. A filament was not evident.

Excretory bladders on each side of anterior half of pharynx.

Discussion.—The genus *Loimosina* differs from *Loimos* in its single deeply lobed testis; its rudimentary cirrus; its relatively larger ejaculatory bulb. The anterior sphincter of the

[2] The generic name indicates similarity to *Loimos;* the specific name is in honor of the late Dr. C. B. Wilson.

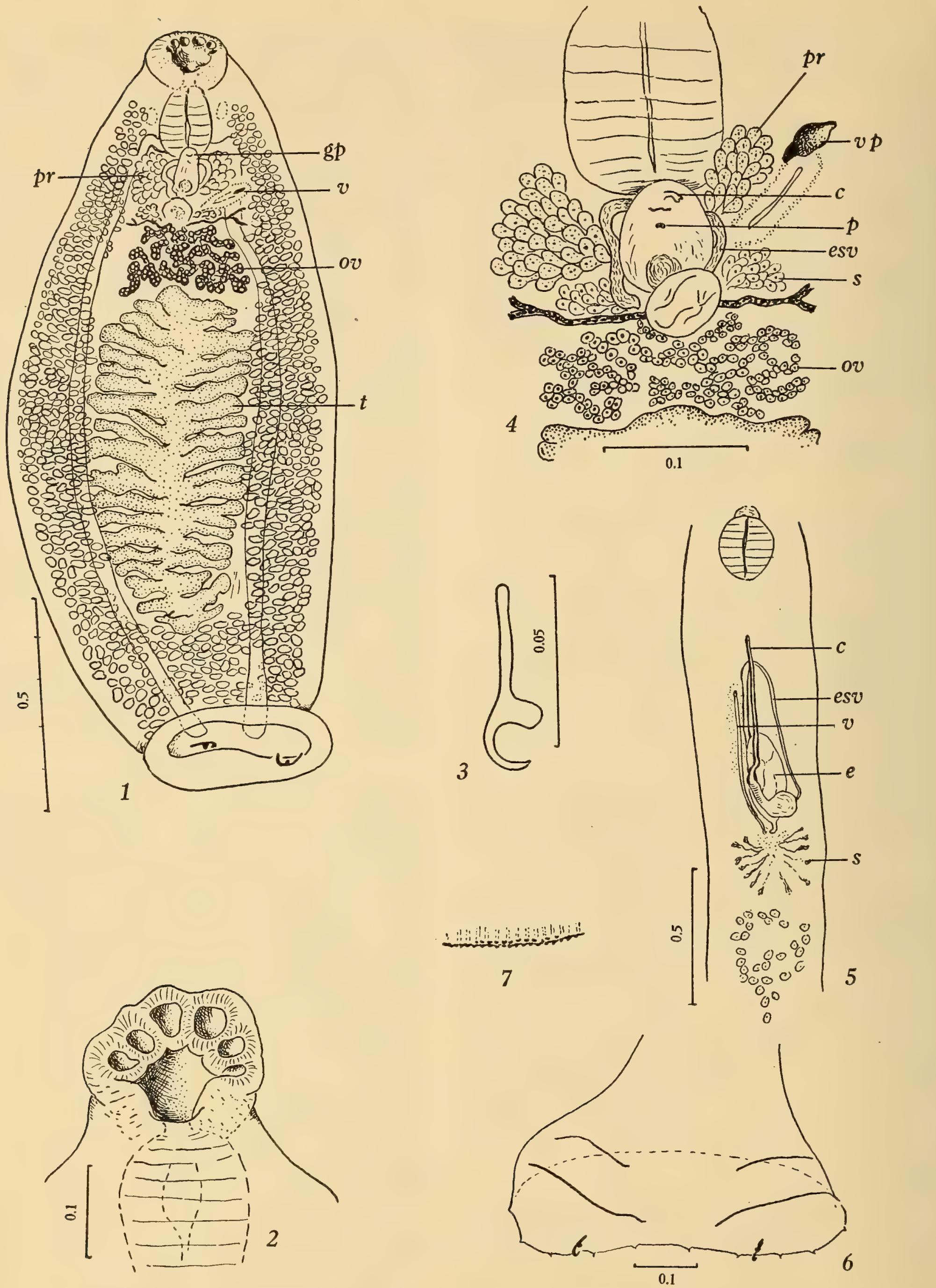

Fig. 1.—Ventral view of *Loimosina wilsoni*. Fig. 2.—Enlarged view of anterior end of *L. wilsoni*, showing preoral loculi or suckers. Fig. 3.—Large hook from posterior haptor of *L. wilsoni*. Fig. 4.—Ventral view of genital complex in region of genital pore of *L. wilsoni*. Fig. 5.—Dorsal view of genital complex of *Loimos salpinggoides*, showing vagina. Fig. 6.—Dorsal view of posterior end of *L. salpinggoides*, showing dorsal, cuticular ridges. Fig. 7.—Enlarged view of the edge of one of the cuticular ridges of *L. salpinggoides*.

All figures were drawn with the aid of a camera lucida. The projected scale has the value indicated (in millimeters). The abbreviations are as follows: *c*, cirrus; *e*, egg; *esv*, external seminal vesicle; *gp*, male genital pore; *ov*, ovary; *p*, uterine pore; *pr*, prostate gland; *s*, shell gland; *t*, testis; *v*, vagina; *vp*, vaginal pore.

pharynx is less evident. The mouth seems to be within the anterior haptor rather than slightly posterior to it. The dorsal cuticular ridges of the posterior end were not seen in *Loimosina*. Most specimens, however, were not favorable to show these structures. If present, they are probably weakly developed.

Price classified the subfamily Loimoinae in the family Monocotylidae. Relationships to other Monocotylidae are seen in the character of the posterior haptor, in the digestive system, and in the terminal male organs. The chief difference from other Monocotylidae is the form of the ovary, which is not U-shaped and does not send a loop around one caecum, but has an irregular form, at least usually consisting of loose cells in sinuous branching tubes.

The following diagnoses are suggested:

Loimoinae: Monocotylidae with ovary not U-shaped and not sending a loop around one caecum, but consisting of loose cells usually in sinuous tubes; anterior haptor with one to three pairs of loculi or preoral suckers; posterior haptor with one pair of large hooks and numerous small hooks; eye spots lacking; two pairs of dorsal, posterior, transverse, cuticular ridges usually present; pharynx with wide muscular bands and anterior sphincter; caeca simple; male pore and uterine pore median, near together; vagina present; vaginal pore ventral, to left of midline; several tandem testes, or single testis; ejaculatory bulb and chitinous cirrus present; prostatic gland present; external seminal vesicle with ascending and descending sections, crossing cirrus or ejaculatory bulb dorsally; uterus short and straight; egg typically with filament; parasites on gills of sharks.

Loimos: Loimoinae with one or two pairs of preoral suckers; cirrus well developed; several tandem testes; dorsal, posterior, cuticular ridges well developed. Type species: *Loimos salpinggoides* MacCallum, 1917.

Loimosina: Loimoinae with three pairs of preoral suckers; cirrus rudimentary; testis single, deeply lobed; prostatic bulb well developed; posterior cuticular ridges inconspicuous or lacking. Type species: *Loimosina wilsoni*.

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ZOOLOGY.—*Description of a new species of Amphipoda of the genus* Anisogammarus *from Oregon*.[1] Clarence R. Shoemaker, U. S. National Museum.

When recently looking up specimens of *Anisogammarus ramellus* among the unidentified Amphipoda in the collection of the National Museum, I noticed examples of this genus from Big Creek, Lincoln County, Oreg., possessing characters quite different from those of *A. ramellus*. Upon study, these specimens proved to represent a new species, which I here describe and designate as *Anisogammarus oregonensis*. Heretofore, *A. ramellus* (Weckel) has been the only species described from the fresh waters of North America. Four fresh-water species of this genus have been described: *A. ramellus* (Weckel), known from California and Oregon; *A. annandalei* (Tattersall), from China and Japan; *A. kygi* (Dershavin), from Kamchatka; and *A. jesoensis* Schellenberg, from Jeso, Japan. *A. oregonensis* appears to resemble most closely *A. jesoensis* but is distinguished at once from it by the possession of a much more elaborate dorsal armature of the metasome and urosome and by the absence of plumose setae from the third uropods.

Anisogammarus (Eogammarus) oregonensis, n. sp.

Male.—Head scarcely produced into a rostrum; side lobes broadly truncate, with upper and lower corners evenly rounding; eye rather large, reniform, and black. Antenna 1 about two-thirds the length of the body; second joint

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a little shorter than the first; third joint half the length of the second; flagellum consisting of about 29 or 30 joints; accessory flagellum of four normal joints and one very short terminal one. Antenna 2 about two-thirds the length of antenna 1; first joint and gland cone of second joint very prominent; fourth joint a little longer than fifth; flagellum without calceoli,

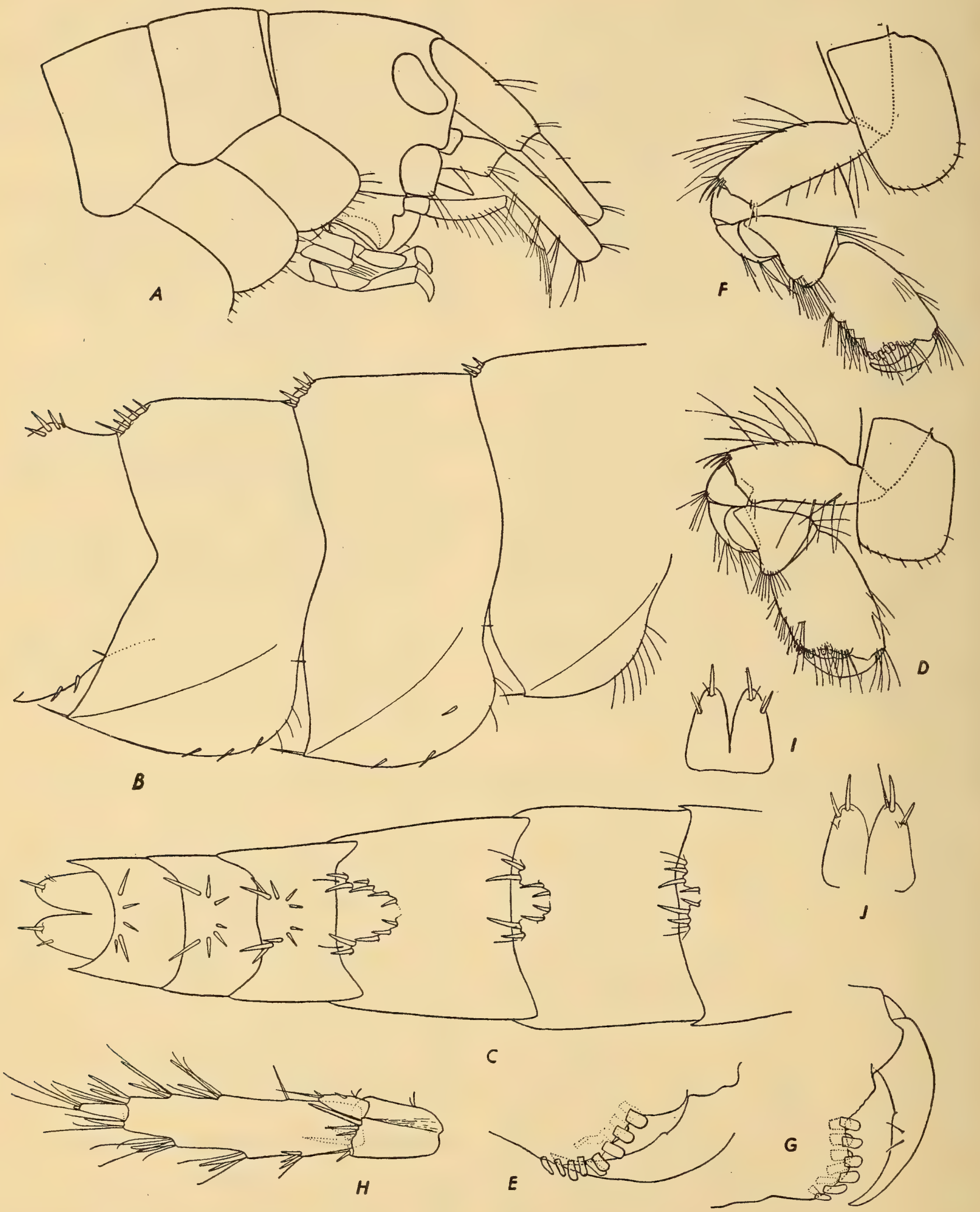

Fig. 1.—*Anisogammarus oregonensis*, new species: Male: *A*, anterior end of animal; *B*, metasome from the side; *C*, metasome, urosome, and telson from above; *D*, gnathopod 1; *E*, palm and seventh joint of gnathopod 1; *F*, gnathopod 2; *G*, palm and seventh joint of gnathopod 2; *H*, uropod 3; *I* and *J*, telsons of other males.

and composed of about 15 joints. Mandible with four teeth on cutting edge; accessory plate well developed and complex; five serrulate spines and two setae in spine row; molar large and strong; palp with third joint very little shorter than the second. Maxilla 1, inner plate with 13 or 14 plumose setae and several short terminal setae; outer plate with 11 pectinate

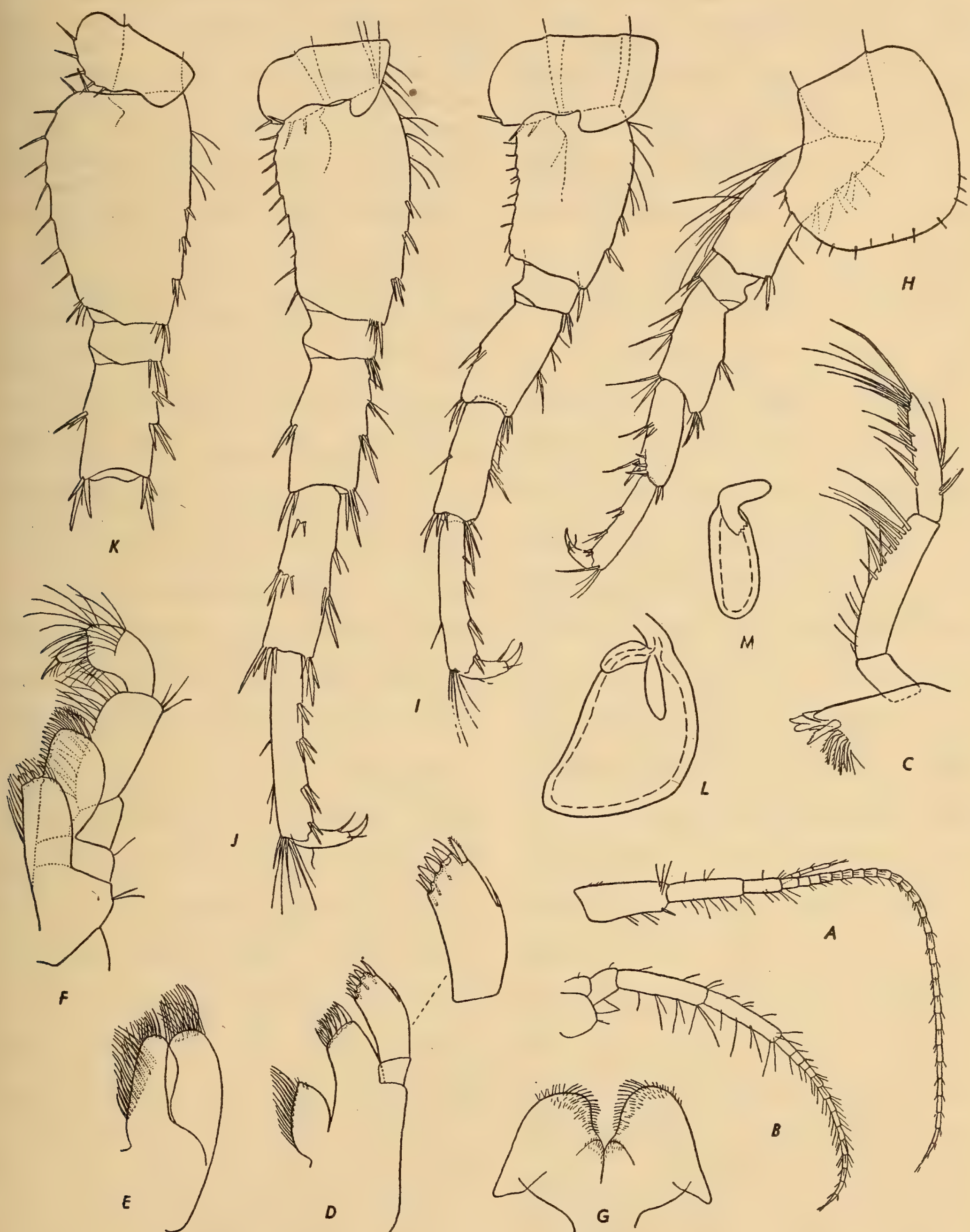

Fig. 2.—*Anisogammarus oregonensis*, new species: Male: *A*, antenna 1; *B*, antenna 2; *C*, mandible; *D*, maxilla 1; *E*, maxilla 2; *F*, maxilliped; *G*, lower lip; *H*, peraeopod 2; *I*, peraeopod 3; *J*, peraeopod 4; *K*, peraeopod 5; *L*, coxal gill of gnathopod 2; *M*, coxal gill of peraeopod 5.

and serrate spine teeth; palp with five apical teeth, the outer of which is very finely serrulate, outside surface of palp with four subapical setae, and one seta near the center of the outside margin of the second joint. Maxilla 2, inner plate bearing submarginal row of about 13 plumose setae. Maxilliped, inner plate armed with three stout spine teeth; outer plate armed on upper half of inner margin with 10 spine teeth and on the rounding distal margin with four or five curved serrulate spines; palp with third joint strongly curved; fourth joint bearing stout nail, at the base of which are three or four setules. Lower lip with inner lobes very indistinct and lateral corners short and obtuse.

Gnathopod 1 a little shorter but stouter than 2; the sixth joint not much longer than wide, the hind margin bearing about four groups of slender spines, each group containing only a few spines; palm oblique, concave, and armed with peglike teeth, which are somewhat crowded together at the broadly rounding defining angle; seventh joint strong, much curved, and bearing a slight protuberance on the inner curved edge. The seventh joint closes upon the inside surface of the sixth joint and rests against an inner row of peglike teeth. Gnathopod 2, sixth joint much longer than wide, the hind margin bearing four or five groups of stout spines, each group composed of both straight and curved spines; palm oblique, concave, and armed with a row of peglike teeth on the outside margin and a row on the inside margin. These teeth are evenly spaced and not crowded together at the rounding palmar angle as they are in gnathopod 1. Seventh joint strong and curved and bearing a low protuberance on the inner curved margin. The seventh joint closes against the palmar angle and rests between the two rows of teeth.

Peraeopods 1 and 2 much alike in form, but peraeopod 1 a little the longer. Peraeopod 3 about equal in length to peraeopod 1; second joint with hind margin slightly concave and lower hind corner forming nearly a right angle; seventh joint strong, curved, and bearing two setae at the base of the nail. Peraeopod 4 longer than 3 but not so long as 5; second joint with hind margin slightly concave, lower hind angle not perceptible; the succeeding joints as shown in Fig. 2, *J*. Peraeopod 5, second joint with hind margin evenly convex; the rest of the limb as shown for peraeopod 4.

Coxal plates 1–4 are about as deep as their respective segments; lower front corners broadly rounding, lower margins bearing spinules. Coxal plates 5 and 6 with lower front corner produced into a small lobe, lower hind margin of plates bearing three or four spines. Coxal plate 7 with lower hind margin bearing five or six spines. The coxal gills bear cylindrical accessory gills which are attached to the upper edge of the primary gill where it joins the peduncle, Fig. 2, *L*, *M*. Each of the first four gills (those of gnathopod 2 and peraeopods 1–3) bears two cylindrical accessory gills, and the last two gills (those of peraeopods 4 and 5) possess one cylindrical accessory gill each.

Metasome segments 1–3 with their lower hind corners slightly produced and bearing an apical spine; lower lateral hind margins each with a spine near the center; lower margin of segments 2 and 3 bearing a few spines and setae, that of segment 1 bearing only setae. The posterodorsal surface of each of the metasome and urosome segments bears a cluster of spines and an occasional seta. The arrangement of these spines is shown in Fig. 1, *B*, *C*.

Uropod 1 reaching back to about two-thirds the distance along the outer ramus of uropod 3, peduncle with two spines on upper outer margin and two at outer distal corner; outer ramus very little shorter than inner with two spines on the outer margin and two on the inner margin; inner ramus with three spines on inner margin and none on outer margin. Uropod 2 reaching back to about two-thirds the distance along the rami of uropod 1, peduncle with two spines on upper outer margin and with one outer distal spine; outer ramus noticeably shorter than inner, with one or two spines on outer margin and none on the inner; inner ramus with two spines on inner margin and none on the outer. Uropod 3, first joint of outer ramus not quite three times as long as the peduncle; second joint about one-fifth as long as the first; inner ramus very short and about the length of the second joint of the outer ramus. The armature of uropod 3, which consists of spines and simple setae, is shown in Fig. 1, *H*. Telson reaching back to the end of or a little beyond the peduncle of uropod 3, deeply cleft, and with the rounding lobes armed apically with a spine or a spine and a long seta, and the lateral margins usually bearing a spine toward the apex. As the arrangement of the

spines on the telson is somewhat variable, I have figured the telson of three different males. Length of male from rostrum to end of uropod 3, 10 or 10.5 mm.

Female.—Female in general like the male, the characters differing only in degree. The antennae are shorter, the flagellum of antenna 1 consisting of about 21 joints and that of antenna 2 of about 12 or 13 joints. The gnathopods are smaller and weaker, and the palm of gnathopod 1 is more oblique and that of gnathopod 2 less oblique. The peraeopods appear to be shorter and weaker. The groups of spines on the metasome and urosome contain fewer spines. Uropod 3 is shorter and is armed with fewer spines and setae. The gill arrangement is the same as in the male. The fully grown females are as long as the males.

Type.—A male, U.S.N.M. 79439, collected by R. E. Dimick, at Big Creek, south of Waldport, Lincoln County, Oreg.

Specimens of this species have been taken by R. E. Dimick in Lincoln County, Oreg., at Big Creek and Fogarty Creek, August 6, 1932, and January 12, 1933; and at Mercer Lake, Lane County, Oreg., November 20, 1932.

ICHTHYOLOGY.—*A new genus and species of pimelodid catfish from Colombia.*[1]

LEONARD P. SCHULTZ, U. S. National Museum.

Recently, while studying some fishes sent to the United States National Museum several years ago by Brother Nicéforo María, a small pimelodid catfish was found that can not be identified with any genus or species as yet described from South America.

Imparales, n. gen.

Genotype.—*Imparales mariai*, n. sp.

This new genus of pimelodid catfish from the Río Meta system at Villavicencio, Colombia (Orinoco drainage), is related to *Imparfinis* Eigenmann and to *Pariolius* Cope.

Body elongate, the greatest depth about 9 in the standard length; head flattened, about intermediate between *Imparfinis microps* Eigenmann and *Cetopsorhamdia* Eigenmann; snout not produced, the jaws equal, mouth terminal; two maxillary barbels; four mental barbels, their bases practically in a straight line; no nasal barbels; premaxillary with a band of villiform teeth, the outer lateral angles rounded and not projecting backward; narrow band of villiform teeth on lower jaw; no teeth on vomer or palatines; the posterior pair of nasal openings slightly farther apart than tubular anterior nasal openings; eye small, without free margin and situated just in front of middle of length of head; head covered with rather fleshy skin, but a small fontanel shows in middorsal line behind orbits; width of head $1\frac{1}{2}$ in its length; occipital process very short or lacking, the space from occiput to dorsal origin being fleshy; dorsal and pectoral spines entirely absent; pelvic insertions under base of first branched dorsal ray; the origin of dorsal and insertion of pelvic fins well in advance of middle of standard length; adipose fin long, its origin an equal distance between middle of length of pectoral fin and midcaudal fin base; the adipose fin posteriorly over caudal peduncle has a deep notch, then continues so it is confluent with the caudal fin; anal origin only a trifle behind a vertical line through adipose origin; anal fin short, of five graduated simple soft rays followed by six branched rays; caudal fin deeply forked, the upper lobe much longer than the lower, both lobes rounded distally; anus between middle of length of pelvic fins, the latter short and not quite reaching halfway to the anal origin; the lateral line appears to end near midaxis of body over front of anal fin base.

Among those pimelodid genera without a free orbital rim, lacking spines in dorsal and pectoral fins, and with as few as 12 anal rays, this new genus differs in having a forked caudal fin with the upper lobe greatly elongate and the adipose fin confluent with caudal fin. *Rhamdiopsis* Haseman, *Acentronichthys* Eigenmann and Eigenmann, and *Heptapterus* Bleeker all have 18 to 28 anal rays, while the new genus has but 12. *Chasmocranus* Eigenmann has the premaxillary band of teeth with backwardly projecting angles and the caudal fin not deeply incised. *Pariolius* Cope has the caudal fin

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rounded and the pelvics inserted well in advance of the dorsal origin, instead of a deeply incised caudal fin and pelvics inserted under front of dorsal fin base as in *Imparales*. *Imparfinis* Eigenmann differs from the new genus in having the pelvics inserted much in advance of the dorsal origin, the anal a little in advance of a vertical line through adipose origin, and the head greatly depressed forward with a nearly straight profile. In *Imparales* the head is not thin forward, and the profile of the snout is rounded. *Cetopsorhamdia* Eigenmann and Fisher differs from *Imparales* by having a deeply forked caudal fin with equal pointed lobes or the lower lobe longest, pelvics inserted under the posterior base of dorsal fin, adipose fin not confluent with the caudal fin, and the mouth inferior in position, the snout projecting. *Nemuroglanis* Eigenmann and Eigenmann has a lanceolate caudal fin and the pelvics reach to center of anal fin.

In the key to the pimelodid catfishes without a free orbital rim by Gosline (Stanford Ichthy. Bull. 2(3): 83–84. 1941) *Imparales* would trace down to *Pariolius*.

Other characters are those of the new species described below.

Named *Imparales* in reference to the unequal caudal fin lobes.

Imparales mariai, n. sp.

Fig. 1

Holotype.—U.S.N.M. 121251, only known specimen, 38.5 mm in standard length and 51.5 mm in total length, collected by Brother Nicéforo María in the Río Meta at Villavicencio, Colombia.

Description (measurements recorded in hundredths of the standard length).—Length of head from tip of snout to end of gill cover 18.4 and to end of supraoccipital 16.9; width of head across base of pectorals 12.7; greatest depth of body 11.2; least depth of body a little in front of base of caudal fin 7.80; length of snout 6.50; diameter of eye 2.08; width of interorbital space 5.20; distance from eye to edge of posterior nostril 1.30; distance from anterior to posterior nostril 2.60; postorbital length of head 10.4; length of maxillary barbel 35.3; length of outer mental barbel 19.5 and of inner mental barbel 13.0; distance from base of last anal ray to midcaudal fin base 20.5; length of base of adipose fin to the notch 35.6; greatest height of adipose fin 2.86; length of simple ray of dorsal fin 12.7, of pectoral fin 10.4, and of pelvic fin 9.10; length of longest (branched) ray of anal fin 9.85, or dorsal 15.6, of pelvics 13.2 and of pectorals 14.0; length of longest ray of upper caudal fin lobe 33.8, of lower caudal lobe 22.1; length of shortest middle caudal fin rays 11.4; distance from snout to dorsal origin 34.3; snout to anal origin 65.2; snout to adipose origin 62.3; snout to pelvic insertion 37.7; snout to pectoral insertion 17.1; snout to anus 44.0; anus to anal origin 22.6.

The following counts were made: Dorsal rays i, 6; anal v, 7; pectoral i, 6–i, 6; pelvic i, 5–i, 5; branched caudal fin rays 7+6; gill rakers short, about 1 or 2+5 or 6 on first arch.

In addition to the characters described above and under the generic diagnosis, the following are recorded: Maxillary barbel reaches a trifle past pelvic insertion; inner mental barbels reach to opposite pectoral insertions and outer mental barbels well past base of pectorals; anterior nostrils tubular, separated by about eye diameter; pectorals not quite reaching to opposite dorsal origin; de-

Fig. 1.—*Imparales mariai*, n. gen. and sp.: Holotype, U.S.N.M. 121251. Drawn by Mrs. A. M. Awl, U. S. National Museum.

pressed dorsal not reaching quite to adipose origin; pelvics reaching nearly halfway to anal origin; dorsal fin margin truncate distally and that of pelvics rounded; middle rays of pectoral longest; anal fin margin rounded distally; gill membranes free from isthmus; mouth terminal, jaws nearly equal; head depressed with broad blunt snout; body compressed posteriorly.

Color in alcohol plain light brown.

Remarks.—This new species differs from all other pimelodid catfishes without free orbital rim, without any spines in the fins, without backwardly projecting angles on villiform band of premaxillary teeth, and without teeth on vomer by having a deeply incised caudal fin with the upper lobe much the longer, the adipose fin notched but confluent with caudal fin, and pelvics inserted under the base of first branched ray of dorsal fin. Additional differences are given in the generic diagnosis.

Named *mariai* in honor of Brother Nicéforo María, the collector of this interesting little pimelodid catfish.

Obituaries

LEONHARD STEJNEGER, who was born at Bergen, Norway, on October 30, 1851, died in Washington, D. C., on February 28, 1943, at the age of 91 and after more than 70 years of active scientific life. To record the highlights of this long and fruitful career is not a simple task.

Few people realized the versatility of his talents. Coming of a musical family related to the composer Edvard Grieg and the violinist Ole Bull, he was trained in his youth to be a concert violinist. His love of natural history was strong enough to force him out of a promising career, and even to cause him finally to go against the wishes of his father, who wanted his son to follow in his footsteps as a lawyer. Young Leonhard did, in fact, take a law degree at the University of Christiania in 1875, but he never practiced the profession. His legal training, however, was of inestimable service to him in weighing the pros and cons of biologic evidence, which was to be his chief concern all the rest of his life. His early youth likewise saw the development of his skill in drawing and painting. For his water-color paintings of birds of his native Norway, made while he was in his early teens, he had to prepare even the paper for his sketches by coating ordinary writing paper with opaque Chinese white, a pigment that gave him a surface capable of taking fine details in feathers and color, which show his extraordinary observational range as well as his splendid control of pencil and brush. It is not surprising that his published drawings of birds in his Asiatic bird papers are as fine as those of any professional scientific artist. His skill in accurate draftsmanship is nowhere better shown than in the maps of the fur-seal islands that he made during his several visits to rookeries of the North Pacific. They have not yet been surpassed for detail and careful measurement.

Although his first interest was in ornithology his work on mammals was of great importance. Our knowledge of the skeletal features of the extinct Steller's sea-cow is due largely to his efforts, while the suggestions contained in his fur-seal report led directly to the control of pelagic sealing and the ultimate recovery of the seal herds that had been nearly exterminated for their valuable pelts. In 1889 he became curator of the division of reptiles and batrachians in the United States National Museum, and for the balance of his life much of his writing dealt with herpetology. In his eighty-fifth year he published a biography of his hero Georg Wilhelm Steller, the young ship's doctor and naturalist who accompanied Bering in his voyages to explore the North Pacific and who was the first white man to set foot on the coast of Alaska after the unlucky Bering had died of scurvy. This work will long remain a model for biographical writing, not only for the painstaking care with which the source material was examined over a period of years, but also for its charming English and facility of expression, very unusual in a man who did not speak the English language until he was 30 years old. His many treatises on zoogeography, especially on the Arctic fauna, will long be consulted. He preferred the Arctic to the Tropics, having been born within the Arctic Circle. Thus he thoroughly understood the physical environment of northern countries from having grown up in one.

Dr. Stejneger's extraordinary powers of application to the problem not only of the moment but for projects begun perhaps years before; his great gift for synthesizing facts to formulate zoologic concepts that have withstood every subsequent test; his retentive memory for books, facts, and personalities encountered in nearly three-quarters of a century of research; his patience in explaining the complexities of animal taxonomy to other students after he had with even greater patience untangled the facts and drawn the proper inferences from them himself—all these qualities are evident from his published work or have been mentioned in the notices that have appeared since his death. What no one could fully realize without having experienced it, was the stimulation of his always timely suggestions to other zoologists with whom he came in contact. He unfailingly found the weak link in a chain of scientific reasoning and was equally quick in pointing out new and better applications of accepted rules. He spent hours of his time in going over manuscripts presented to him for criticism and was never known to shirk his responsibility in giving a full, fair summary of his well-considered opinions. His knowledge of practically every European language brought him a wide correspondence with scientists in every corner of the globe. When he was over 80, he set himself the task of learning Polish in order to translate for his own satisfaction some old records of Bering's and Steller's travels published in that language.

He was happy in the land of his adoption to which he came in 1881. Although he looked forward to periodic visits to his homeland, his real interests were centered in America. He loved to entertain his friends, and with his wife, who similarly enjoyed company, he kept a stream of guests of all nationalities flowing constantly to his beautiful home. He had all the social graces, and on the night of his eightieth birthday he danced until 3 A.M. at his own birthday party. A special dispensation during the Hoover administration granted to him and a few others above retirement age a life tenure of their very important positions.

His last days were greatly saddened by the war. He hoped constantly for news of his sister, not heard from since the Nazis invaded Norway. When the Museum was ordered to evacuate type specimens and other unique material, he, as head curator, personally supervised the packing and shipping out of all the more valuable specimens and records pertaining to the department of biology—this when he was over 90, an age at which most men would be willing to delegate such tasks to younger shoulders.

DORIS M. COCHRAN

GEORGE WASHINGTON LITTLEHALES, an original member and a past vice-president of this ACADEMY, died on August 12, 1943.

Born on October 14, 1860, at Pottsville, Pa., Mr. Littlehales graduated from the U. S. Naval Academy in 1883 and entered the service of the U. S. Hydrographic Office in 1885, where he served until his retirement in 1932, a period of 47 years. His long career in this office brought him recognition not only in this country but in the international world of science. An eminent mathematician, oceanographer, and civil engineer, he was the author of many Hydrographic Office publications dealing with navigation, terrestrial magnetism, oceanography, and related subjects.

In addition to his association with the Washington Academy of Sciences, he served as chairman of the Section of Physical Oceanography, American Geophysical Union; vice-president of the Section of Oceanography, International Union of Geodesy and Geophysics; and vice-president of the American Geophysical Union. A member of the Philosophical Society of Washington, he served as president in 1905. He was also a member of the American Society of Naval Engineers.

As a delegate from the United States, he ably represented the Hydrographic Office and the various scientific bodies at numerous congresses and councils on hydrography, oceanography, and terrestrial magnetism throughout the world from 1919 until his retirement from active life.

In the passing of Mr. Littlehales, the scientific world has lost a preeminent scholar of the nautical sciences whose entire life was devoted to the advancement of knowledge in a field that will greatly feel his loss.

G. S. BRYAN

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JOURNAL

OF THE

WASHINGTON ACADEMY OF SCIENCES

VOLUME 34 APRIL 15, 1944 No. 4

ETHNOLOGY.—*Sanitation and health in a Japanese village.*[1] JOHN F. EMBREE, Civil Affairs Training School, University of Chicago.

INTRODUCTION

The present war in Asia has caught America with an acute shortage of first-hand, reliable knowledge of many aspects of Japanese culture. One such aspect is that of sanitation and health, as the writer has discovered in connection with instruction in an Army Civil Affairs Training School. For this reason the available first-hand data on the subject, as they apply to a specific community in Japan, have been brought together in this paper.

Suye Mura is a small country village in Kyushu, the inhabitants of which gain their livelihood largely through cultivating paddy field rice and to a lesser extent through raising silkworms.[2] Though a long way from Tokyo, it is not too far from Nagasaki and Kumamoto City, where there has been a long history of contact with the West. Its standards of health and sanitation, while considerably more backward than those of the town or city in Japan, probably do not differ basically from conditions in other villages. The relative shortage of doctors and the high consumption of patent medicines, for instance, are reflected in the national statistics, which show that in Japan there is an average of 7.65 doctors for every 10,000 people,[3] approximately half the figure for the United States, and that for patent medicines there is an annual expenditure of about ¥130,000,000.[4]

[1] Received February 26, 1944.

[2] The data given here were collected in 1935 and 1936. A description of social life in the village may be found in *Suye Mura, a Japanese village*, University of Chicago Press, 1939.

[3] Japan Year Book, 1939–40.

[4] Far East Year Book, 1941.

CIVIC PROVISION FOR SANITATION AND HEALTH

There is in the village office a sanitation bureau and in each hamlet a special person concerned with matters of sanitation, the *eisei kumichō*. Frequently he is the same person as the hamlet headman (*buraku nushidōri*) or the head of the hamlet agricultural association (*buraku kokumiaichō*). He may hold his office either through election or by a system of rotation. His chief functions are in connection with house-cleaning examinations and vaccination. There is also a cemetery overseer whose duties are to check on the condition of graves and see that they are deep enough to prevent dogs from digging in them. He is also charged with the duty of preventing any illegal exhumations and seeing that no body is buried sooner than 24 hours after death. This last rule is to insure against burying someone alive through an error in diagnosis of death. The village office also maintains on its rolls a doctor for the purpose of preconscription health examination for boys from the village and an annual smallpox vaccination at the village school.

All these functions are only occasional duties of the persons concerned. The sanitation officers are mostly regular farmers, as is the cemetery inspector. The doctor lives and carries on his practice in a nearby town, coming to Suye only when his duties as Suye public-health doctor demand it.

The local police assist the village officials in the carrying out of their public-health duties and of course may be called upon to enforce any rules which are not obeyed. The need for this, however, is rare.

STANDARDS OF CLEANLINESS AND HEALTH

Standards of cleanliness in the village are different from those in, say, an American small town. They also vary considerably according to local standards from individual to individual. In house-cleaning, for instance, it is essential that the straw floor-mats (*tatami*) be kept clean. On the other hand, the use of the same dishrag day after day, both as dishrag and as towel, is also considered quite proper. The average farmer takes a bath practically every day, but runny noses among the children pass unnoticed and are considered no offense. In regard to local variations, the upper-class groups, who incidentally are better able to afford cleanliness, are likely on the whole to observe strictly the traditional Japanese standards of hygiene. In regard to drink exchange, while in the towns, as a rule, the drinking cup is rinsed off in a bowl of water between exchanges, no such refinement is observed in the village.

The hair of young girls and even of adult women is often infested with lice. Most of the farmhouse *tatami* contain a peculiarly aggressive form of flea (*nomi*).

Within the Mura there is a fairly wide range of knowledge and practice in regard to matters of sanitation and health according to social and occupational status. One or two of the more well-to-do individuals who have been away to college, the midwife, and a few others have a much better comprehension of the cause and prevention of disease than does the average villager. Similarly, shopkeepers and schoolteachers, with their wider knowledge of the modern world than the person who rarely travels, are not so likely to follow traditional folkways.

PLUMBING

There is no plumbing of any sort in the village, water being obtained from wells and streams. Night soil and manure are carefully preserved to be used as fertilizer in the fields, and there is practically no garbage to be disposed of. There are, for instance, no meat bones in the village, because the people eat no meat. The carcasses of dead animals, such as horses, are bought up by certain people in the towns for the use of the hides and the bones. Bean-curd (*tōfu*) waste is fed to the pigs kept by the *tōfu* makers. The pigs in turn are sold to city dealers.

The bath and toilet of the village farmhouses are not a part of the main building but are usually in the form of outhouses somewhere in the house yard. There is usually a bucket set in the ground to serve as a urinal somewhere in the front yard near the structure housing toilet and bath. It is used by the men much as in the Occident, while women stand over it facing the yard, bending forward and hiking the garments to the knees in such a way that they may urinate without either soiling their garments or exposing themselves. The urinal is only partially protected by a doorless wooden covering; sometimes it stands quite in the open. A branch of evergreen may be placed across the top to serve as a deodorant. The outhouse toilet is enclosed and has a door. It is used in such a way that one squats over an opening rather than sitting, thus avoiding any spread of disease by means of toilet seats. There is no plumbing attached to either the bath or the toilet. The bath requires filling with water and heating by a fire built underneath it every afternoon. The same bath water is used, as a rule, by the whole family or even by several neighborhood families in order to save the work of filling several tubs and laying several fires. However, the general practice is to wash one's self off first and then get into the tub for a hot soak.

The water is supplied from wells in yards and ditches or from nearby fresh-water streams and springs. As a rule, most water is taken in the form of soup or tea and so has been sterilized through boiling. Dishes and trays, however, are washed in cold water.

REFRIGERATION

There is no refrigeration in the village, although it does exist in the small towns of the area. A man, such as the fishmonger or the ice-cake[5] maker, maintains refrigeration from natural ice or from refrigeration apparatus. However, even in the towns, refrigeration is restricted to such special occupations and is not a characteristic of

[5] A kind of "popsicle."

the average household. Cases of illness resulting from eating contaminated ice cakes are occasionally reported in the towns.

HOUSE-CLEANING

Daily house-cleaning includes the rubbing off of the *en* or wooden runway by one side of the house and the sweeping out of the front yard or the dirt road in front of the house. In fact, the day usually begins with a brisk sweeping of the dirt yard or road to be followed later by a hasty dusting of the interior. Dishes are washed in cold water, the same dishrag being used for both washing and wiping. Since there is no greasy material in the local diet, this cold-water washing is sufficient to keep the dishes presentable. Trays and other eating utensils, which are only used from time to time for special banquets, are usually washed just before using rather than when being put away. On dusty days, the roadway in front of the house is sprinkled with water.

In Japan it is the rule that houses must be cleaned two or three times a year, and in Suye the dates come in April and July. The lack of a house-cleaning period in January or February may be due to the cold weather. House-cleaning, which is woman's work, consists in removing the paper sliding screens (*shōji*) and removing the *tatami* and other movable parts of the house and taking them outdoors where the *shōji* are washed off and the *tatami* beaten. The floor boards under the *tatami* are wiped and fresh bamboo branches are used to brush off the walls and ceilings. Movable objects and bric-a-brac are simply moved about while the surfaces on which they stand are cleaned, but the dust of the ages on the bric-a-brac itself goes undisturbed. On the appointed day, the village sanitary inspector and a policeman come around to inspect each house to see that it has been properly cleaned. A house must be pretty dirty not to pass. Each housewife is given some carbolic-acid disinfectant at this time to be put by the toilet, around on the dirt floor of the kitchen, and in the dirt areaway by the entrance, areas subject to wetness; the carbolic acid is intended to be used as a protection against epidemics as well as to kill insects.

Household bedding is laid out on the floor in the evening and rolled up and put away in a closet during the day. It is not unusual for a man to go to sleep with his regular clothing on, and school children often sleep in their school uniforms.

VACCINATION

The Japanese Government has for some years maintained a thorough program of smallpox vaccination, one that reaches out to include every village and hamlet of the nation. In Suye Mura, for instance, once a year, all the one-year-olds and all the ten-year-olds are gathered together at the school for this purpose. There is a check-up of those vaccinated a week later. The doctor employed by the village office performs the actual vaccinations. There have been no epidemics of smallpox in Suye Mura for over 30 years.

HOSPITALS

There is no hospital in the Mura, and as a rule villages are without such medical service. On the other hand, there is a small hospital in a nearby town run on a somewhat cooperative basis. Two of its councillors or trustees are people of Suye, one of whom happens to be the village headman. The rooms in this hospital, like those of many Japanese hospitals, are very much like rooms at home with *tatami* floors, and the bed is made up directly on the floor. It is the custom for relatives to visit a patient at frequent intervals and for long periods, even eating with him and helping to nurse him. As a rule, people from Suye Mura go to a hospital only when seriously ill, and many people who would be hospital cases by American standards never see the inside of a hospital room. Also, as might be expected, it is only the more well-to-do who go to the hospital, because of the expense involved.

There is a small isolation building in the village for the purpose of taking care of any person who should be taken down with a seriously contagious disease. It has not been used for that purpose, however, for 20 years.

DOCTORS AND MIDWIVES

There are very few doctors in these rural

areas, and there is no doctor at all in Suye Mura, though there are some in the towns and one in the neighboring village. One of these doctors may hold a weekly clinic in the Mura if he thinks it will be profitable. Doctors must certify to deaths for village office records, and such death certificates usually cost 25 to 50 sen. In regard to health matters, doctors are regarded as rather expensive by village standards since they charge 1 to 2 yen per visit. Furthermore, some of the older rural doctors are not especially well trained as medical practitioners. There is no dentist in the village, and people with serious tooth trouble must go to a town or city dentist.

A typical country doctor in this area is Dr. K, of Fukada Mura, a couple of miles from Suye. His degree of training is somewhat doubtful, but his success financially is beyond any doubt. His residence is an imposing one, and he makes his calls in a little Ford roadster, one of the very few motor vehicles privately owned by anyone in this area. He has a rather superior attitude in regard to the local farmers and by his own testimony does not like living in the country. He says that he buys ¥10,000 worth of medicine a year but only receives ¥2,000 for it. He makes his money rather as a landowner. These statements can best be understood by realizing that by Japanese standards it is more important to be from an old landowning family than to make one's money through trade. Nonetheless, the statement should be taken with considerable skepticism. Dr. K, like some other doctors, occasionally complains about the faith healers or *kitōshi* of the area, claiming that people go to them until the sickness becomes very serious before calling in the medical doctor.

There are two midwives in the village, women who have been trained in special schools and who are licensed to practice midwifery. They attend births and look after the mother.

A favorite doctor's remedy for pains of various kinds from boils to female diseases is the use of injections or *chūsha*. The villagers attach considerable value to these injections, and it is possible that they serve as a psychological substitute for such folk practices as *mogusa* and acupuncture described below.

When ill, most people simply stay at home and go to bed. A young wife may go to the home of her parents if she becomes sick. Only in extreme cases does one go to a hospital, and such extreme cases do not include childbirth. The family is likely to visit a faith healer or administer some home remedy as a first means of regaining health. The doctor is called, as a rule, only as a last resort, often when a man is on his deathbed.

FAITH HEALERS

Faith healers or *kitōshi* are men or women who, by means of prayer and incantations, cure illnesses, drive out evil spirits, and in general bring a sick body back to health. They may effect their cures with the aid of either Buddhist or Shinto deities. An Inari[6] *kitōshi* is especially popular in Suye as well as one old, blind healer who maintains a small, run-down Tendai[7] temple. The *kitōshi*, on the whole, do not belittle the use of doctors and medicines, and there are instances of their actually recommending that their clients go to a doctor for treatment. They have no set fees, people giving them gifts of rice, eggs, etc. Most *kitōshi* (and Shinto shrines) have for sale special charms and medicines for everything from horses' health to fertility in women.

Yakushi, a special Buddhist deity of medicine, is occasionally enshrined in local priestless hamlet temples (*dō*). While most ills are regarded as of natural origin, some sickness is attributed to witchery by means of an *inugami* (dog spirit) or *nekogami* (cat spirit) instigated by the malevolence or envy of some unpleasant neighbor. Such sickness, of course, would call for the immediate attention of the *kitōshi*. Some people patronize the faith healers regularly as a kind of health insurance.

MEDICINES AND PILLS

Medicines are much used in the Mura.

[6] A popular Shinto deity of good fortune, patron deity of farmers and of *geisha*. His messenger is the fox.

[7] A Buddhist sect formerly strong in Japan but today less important than such sects as Shinshu, Zen, and Nichiren.

Families may spend as much as a yen a month for medicine, and a single household may have on hand as many as seven to eight different medicines. There are very few, if any, legal restrictions as to what the label of a medicine bottle or box may say. Most of them claim the contents to be general cure-alls, and most of the purchasers believe what the label says.

The medicines are obtained from a number of sources. A few people purchase certain medicines from the agricultural association, and doctors frequently give medicines in connection with other services. There are also many druggists in the nearby towns who sell all sorts of medicines as well as a number of itinerant medicine sellers who go through the village from time to time. Home remedies of various sorts are also common.

Sometimes people visit hotsprings as a means of restoring their health. There are some small springs at Yunoharu, not far from Suye, a somewhat better one at Hitoyoshi, the old county capital 12 miles away, and occasionally someone from the village may go as far as the famous springs of Beppu, a day's journey by train.

ITINERANT MEDICINE SELLERS

A Korean peddler of ginseng or Kanton no ninjin.—This man comes through the village from time to time selling his wares and gossiping with the housewives. He says that if you are sick ginseng will make you feel better, and even a little bit will cure a fever. He also claims ginseng to be good for headache, cold, female troubles, gonorrhea, and syphilis and a cure for sterility. This wonderful medicine does not come for nothing, and the seller charges ¥7.50 and up per root. However, a little goes a long way, a bit of it being scraped off and boiled into an infusion, which is then taken internally. Ginseng, incidentally, is a Japanese Government monopoly in Korea.

Patent-medicine sellers.—There are a number of different patent-medicine sellers who pass through the village from time to time selling their wares. The practice is for

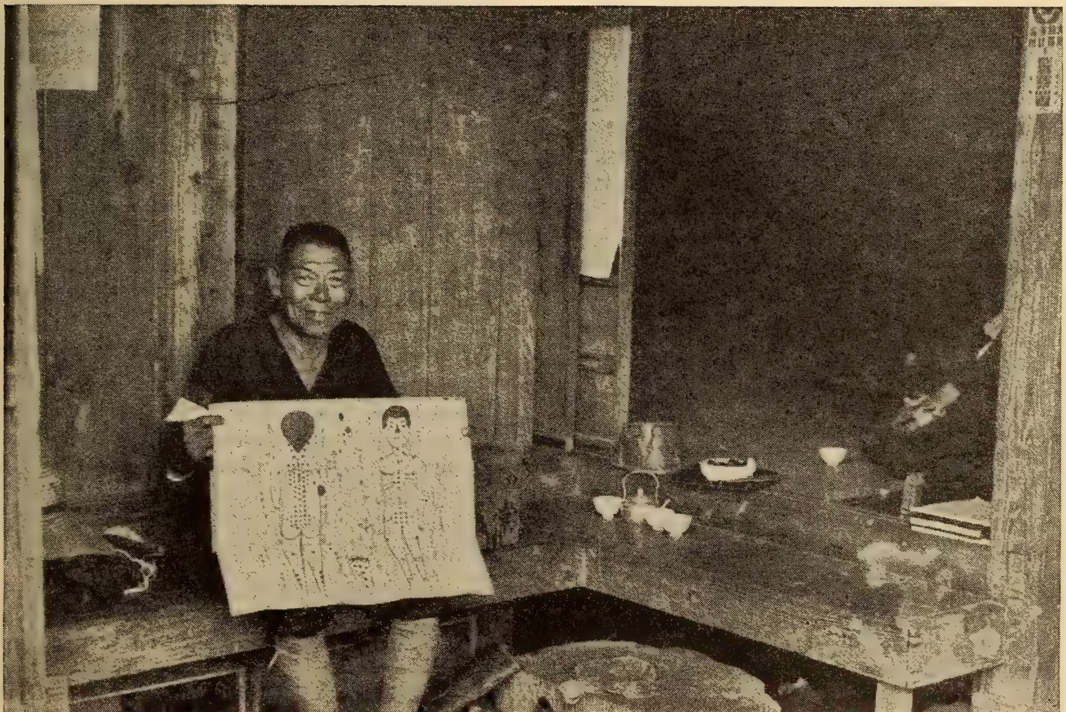

Fig. 1. *Beni* seller being given a cup of tea by a farmer's wife. The chart he holds shows how *beni* may be applied.

them to leave with a given housewife a number of pills and powders without charge, then to come back in six months or so, at which time the customer pays only for what she has used.

Beni *seller.—Beni* is a red liquid looking somewhat like mercurochrome, and there is a particular man who comes through the Mura from time to time peddling it from house to house. According to the *beni* seller, his product is good for many ills. If you have a fever, put it upon the soles of your feet; if you have stomach trouble, put some on the lower chest; if you have troubles of the womb, place some on the belly; if you have gonorrhea, put some on just above the sex organs; if you have arm or shoulder trouble, put some on the arm; if you suffer from headache or *histeri*,[8] put some on the temples and the crown of the head. *Beni* stings on application and leaves a bright red spot for a few days after application and so has a good psychological effect. Many people in the village use it, especially for headache.

COMMON TRADITIONAL TREATMENTS

Three common traditional treatments used in Japan are acupuncture, moxa, and massage. All three go back at least to early Tokugawa days, and in one form or another they are also practiced in the rural areas of Korea and parts of China. Most of these three treatments are performed by older women of the village who are regarded as experts.

Acupuncture.—This is a treatment involving the use of a needle in a bamboo sheath. A case description[9]:

> Mrs. K, wife of the Inari *kitōshi*, got a sore neck and shoulder. People suffer from stiff necks and shoulders and backs, very often—whether from overwork or rheumatism due to damp and cold winters I do not know. She came for a massage to Mrs. Sawada [an old woman of a poor farm family living in the same hamlet as Mrs. K]. The old lady is famous for it. At first she massaged her sitting down, then made her stretch out and pressed her neck stressing the sore spots. Then she used the needle—a metal needle blunt at the end which is put into a bamboo tube about $1\frac{1}{2}$ inches long. She applied the tube to the sore spot, then by flipping her fingers got the needle, protruding on top at first, well into the flesh; then removing the case she twisted the needle. No blood appeared. The pain was said to be much relieved by the treatment. In her bag containing the massage material the old lady had a bottle of alcohol which she rubbed on her hands and the needle—she did not know why she did it but the old lady I—also present—said it was a disinfectant. But after the alcohol wash she passed the needle through her hair to make it glide, as is done in sewing.
>
> The old lady learned her trade herself, bought the needle at Taragi, gets a few *sen* for her services ("*kokoro kara*"—from the heart) from each patient.

It is to be noted in this case that the functions of the acupuncture expert and the *kitōshi* do not conflict. In a case calling for acupuncture even the wife of the *kitōshi* visits the proper specialist. The case also brings out the varying degrees of knowledge of different persons in the village. Old Mrs. S, a rather unsophisticated woman, wife of a farmer, has learned her trade from a specialist in the town more or less by rote as one would learn a magical formula—hence the alcohol is used as instructed, but she is ignorant of its purpose as evidenced by her own statement and by her subsequent action in running the needle she has sterilized in alcohol through her hair to make it smooth. Mrs. I, on the other hand, is the wife of a broker and business man and knows the purpose of the alcohol, though it is possible that even she did not see the inconsistency of running the sterilized needle through the hair.

Moxa (mogusa).—This is a cure involving the burning of bits of dried-up young leaves of the Chinese wormwood (*Artemisia moxa*) usually on the back and sometimes on thumbs held closely together or on the back of the hand. The burning of the skin is said to "take the pain away." A case description:

> In Nakashima I came across old Mrs. G having her back burnt. Her daughter-in-law was doing it. First she passed an iron rod through a pipe stem to get it stained, then, locating the sore spot by pressing her finger, she would make a small spot with the rod. After that she put a tiny bit of *mogusa* on all the marked spots and burnt it by applying a stick of incense (*senko*). Each spot was gone over and over again until one layer

[8] See below.

[9] This and the other case descriptions given below are from the field notebooks of Ella Embree.

of skin was burnt off. The burnt moxa was scraped off with a finger before applying more stuff. Through all this the old lady never uttered a sound. Yet when a bit of burning stuff was dropped by mistake on the wrong spot, she shuddered. They do not do it regularly, but say that if done twice a month the back would not ache at all.

Massage.—Massage is done both by hand and with special sticks. A case description:

Mrs. I of Imamura when I stopped there this afternoon was just having her last bit of massage. It was being done by a specialist from Menda who calls his massage *himeri*—moving of muscles to restore circulation, as against the common variety of *amma* ("as done by untrained people in the country") or massage done outside of Japan. He thinks his massage can cure many troubles—bruises, stomach diseases, skin eruption due to bad circulation. He knew something of anatomy and a few English terms he picked up somewhere (one of his brothers is in America now). He is also the representative of a medical manufacturer and sells just one brand of medicine and warns you against counterfeits. He has pills for internal troubles, *karumin* being the most popular and good for settling stomachs, counteracting constipation, overcoming diarrhea, preventing dizziness and curing headaches. He also has ointments. As premiums and ads he distributes two flags—a large national flag and a triangular navy flag both with company's trade mark on it. This trade mark is also represented in a gold-braided medal on his cap—which makes him look like a railway official. Took up this business because he has very poor eyes and could not do any studying.

He comes to the village regularly at certain intervals and has been coming more often now to give Mrs. I her treatment. She did not see me when I came and lay there moaning with pain, covering her eyes up with her arms. She was quite naked and had a kimono thrown over her. After the operation she looked all done in. But her skin is much better. The pills he left with her said (in English) "For gonorrhea, catarrh of the biadder and testicles." In Japanese there was a long description which mentioned gonococcus. To me she said nothing is the matter with her internally and the medicine is merely to clear the system out now that the eruptions on the skin are over and her blood circulates properly. She complained about the price of the stuff—one yen a bottle and the dose is thirty pills a day.

COMMON ILLS

There are a number of common ills that afflict the people of the village and that are for the most part accepted as a part of this world's inevitable misfortunes:

Skin diseases, rashes, etc., are very common, especially in children. One child's skin disease is known as *mizu bōsō*. Common remedies are ointments and powders. Rashes are especially common in hot weather, and more faith seems to be put into powders and ointments than in washing as a preventive or cure.

Colds and chest troubles.—These occur in both adults and children. Children go to an unheated school, which is regarded as good self-discipline for them. Infants are frequently subjected to exposure of various sorts in cold weather. When an infant wants to relieve himself, for instance, his mother lifts his kimono, opens the *shōji*, and holds him outdoors till he is finished.

What Dr. K calls influenza is also a common ailment in the village and a serious one.

One home remedy for a cold is garlic in soup or mixed with brown sugar. "Garlic is good for the health" is a common saying just like "wheat is good for the health." (The peasants do not like wheat in their rice, but when eating it as an economy measure console themselves with this phrase.)

Cerebral hemorrhage and stroke (Nōikketsu, nōshukketsu).—This is frequent among the old and is often fatal. The doctor is usually called in to diagnose an attack, but most of the care is by the family and at home. One doctor lays its high incidence to overdrinking. He also cites liver ailments as due to the same cause.

Chūbu, a kind of paralysis, is also common among the old people. (Hepburn translates *chūbu* as hemiplegia.).

Venereal disease.—Syphilis (*baidoku*) and gonorrhea (*rinbyō*) both occur in the village but do not seem to be especially common, judging by the fact that no cases were found by the army doctor among the conscripts in Suye in one year. However, these diseases are much talked about and form a favorite topic of malicious gossip. A specific case:

One baby died of congenital syphilis after a period of illness. According to the father: he read of some medicine in a magazine and sent for it; the baby recovered rapidly, too rapidly, for all the poison was not yet out of the body; this caused an explosion of the veins in the head and, hence, the baby died.

One remedy said to be good is a mixture of snakeskin and *shōchū* (a distilled rice

liquor). Some women say that *shōchū* is good for female genital diseases.

Stomach troubles and intestinal diseases.—These are especially common in children who eat irregularly and frequently overeat of starchy foods, such as the heavy rice cakes made on the occasion of various holidays. In fall, stomach trouble from eating green persimmons is common. *Ekiri*, a form of dysentery, is also common with children.

In the event of vomiting, due to indigestion or too much liquor, cold water is administered and the vomit is covered with ashes by one of the women of the household.

Backache, pains, stiff necks, stiff shoulders, and backs (rheumatism and arthritis).—These chronic ailments are especially common among older women. The chief remedies are massage, moxa, and acupuncture. (See above.)

Women's diseases, pains, and uterus troubles (fujinbyō).—Diseases and pains of the uterus (*shikyū* or *sh'kyū*) are especially bad and seem to be due to a lack of proper postnatal care. The midwife says that the women get up too soon after childbirth and do not take proper care of themselves. Local custom in this regard is described below.

Accidents.—Burns and cuts are common. Burns may occur from a child's falling into the *irori*, or fire pit. Such burns may be treated by a doctor or by some home remedy such as *kaki no shibu* (an astringent made from persimmons). Patent medicines may also be used. The bacteriologist Noguchi had one hand seriously damaged by such a burn.

Cuts may be treated by a doctor as, for instance, in the case of a boy falling from a tree and cutting himself. Cuts in the fingers and legs are especially common. One home remedy is salt and hot oil applied externally, as in the case of a young woman who had a cut from bamboo on her leg that had become swollen.

Cancer.—Cases diagnosed as cancer are rare, though the Zen priest died of cancer of the throat. With the relatively high death rate and low age expectancy, it is possible that cancer actually is less common in Japan than in, say, the United States. (The national statistics for Japan tend to bear out this statement.)

Leprosy.—Leprosy is rare in this area. There were no cases in Suye itself. Leprosy is regarded by the people as a disgrace to the family. It is very difficult for relatives of a leper to get married. Villagers regard leprosy as being due to bad blood and hence inheritable. According to one of the doctors in the region, mild cases are registered with the police and given an injection of some sort of oil (chaulmoogra?). More serious cases are sent to an isolation hospital in Kuroishibaru, Kumamoto.

Tuberculosis.—The incidence of this is uncertain though the national tuberculosis rate is high. Like leprosy, it is regarded as a disgrace to the family and so cases of it are likely to be hushed up.

Malaria.—According to a local doctor, there is no malaria in Kuma County. There were quite definitely no cases in Suye in 1935–36.

Typhoid.—This occurs in epidemic form in Kuma, according to a local doctor. However, there has been no incidence of it in Suye recently.

Insanity.—Insanity, like leprosy, is regarded as a family disgrace, and it is not mentioned if possible. People will simply say that so and so is ill or has a cold, etc. If a person becomes violently insane, he may be locked in a special room with the permission of the police, or he may be sent to a hospital at the medical college in Kumamoto. Mild cases are not treated in any special way. Insane persons do not get married.

Feeblemindedness.—This is usually taken care of at home. The feebleminded person is given simple chores to do around the house. Feebleminded persons rarely get married, though this is no guarantee that they will not have children.

Nervous breakdown.—Something resembling nervous breakdown occurs. It is due to worry and anxiety and occurs especially among women when marital relations are bad, work in the home difficult, etc. A variation of this, known as *histeri*, or hysteria, also occurs. A characteristic of a woman with *histeri* is that she develops a sort of nymphomania characterized by uninhibited

aggressive sexual remarks and behavior toward men.

Childbirth.—Childbirth always takes place at home and in private. Even the midwife may not be present until after the child has been born unless it is a difficult delivery. In mountain hamlets, most of the women have their children quite alone. It is the custom that a woman should not cry out at childbirth "or people will laugh." As one woman put it, they would say "you were quiet when the nice things happened, but cry now."[10]

The old local posture for childbirth seems to have been sitting or squatting, holding on to something for support. The midwife today, however, recommends that mothers lie down.

It is always a midwife, not a doctor, who is called in at the time of a birth. She puts drops of silver nitrate in the eyes of the baby at birth and gives the mother advice on caring for the new-born infant. While infant mortality during the first year is less than in former years, it is still fairly high. Deaths in childbirth and stillbirths also occur occasionally. A stillbirth is as likely as not to go unrecorded in the village office records.

The afterbirth is buried somewhere in the house yard, and the father then steps over it. There is a belief that the father should do this because the child will fear the person who first steps over the afterbirth, and it would, of course, be very undesirable for a dog or some other animal to do this. The umbilical cord is usually saved and tucked away in the rafters—according to some, so that the baby will learn well; according to others, as a means of protecting its health. Ultimately it seems to be consumed by mice.

The mother is usually up on the third day, when there is a special naming ceremony for the infant. She is not supposed to do heavy farm work until about a month after the birth, when there is another special ceremony. However, she is up and around the house and yard, frequently doing rather heavy work, thus contributing to the heavy strain to her system. Such practices may be a cause of much of the older (35 and over) women's illnesses in the village. If she did not do her share of housework after the thirtieth day, she would be subject to the criticism of other women for being lazy and self-indulgent. When the 30-day period is over, even though she may not be well enough for field work, local custom and public opinion exert such strong sanctions that she must do her share of farm labor.

It is a peculiar fact that there appears to be no menstruation for about a year or more after a birth among the village women, although there may be a rather long flow immediately following childbirth. This phenomenon appears to be characteristic especially of the farm women and may be associated with the fact that they are up and working in the fields before their system has regained its normal postnatal functioning.

Abortions are rare, and there was only one case in Suye by a woman of a non-village family who was regarded by the people of Suye as crazy.

Circumcision occurs frequently but is by no means general. The operation is performed around the age of 17 or 18.

MISCELLANEOUS MINOR AILMENTS AND HOME REMEDIES

Minor ailments of various sorts are legion, as are also the remedies therefor.

Fish poisoning occurs. For toothache and headache, which are common, *beni* is frequently applied. There is a *Jizō-san*[11] stone regarded as good for toothache and another one regarded as good for earache in the Mura. Boils are common and may be cut by a doctor or treated with some special medicine. Sore throat occurs occasionally. Two cases of bad eyes were treated by doctors in Menda and Hitoyoshi, but the exact troubles were not ascertained. I once saw an old woman with something in her eye and a younger woman naked from the waist up (it was in July) rubbing the affected eye with a damp towel after which

[10] This taboo on crying out at childbirth is characteristic of a number of tribes in northeast Asia, such as the Chukchee, and perhaps dates back to a very early period of Japanese history.

[11] A popular protective and beneficent deity of Buddhist origin.

she squeezed some milk into it from her breast.

There was one mention of neck-gland trouble. The patient first tried a doctor then tried a remedy called *buri* and moxa, and finally he went to a hotspring. There are some plant allergies, one case of rash being attributed to contact with the *haze* plant (wax tree). There was one case of a large head cyst (?), which was cut out three separate times. The last operation was performed at Taragi Hospital and cost ¥8.50. One man had a kind of sleeping illness. He would work a few days and then sink into a sort of coma for a period of days. He was said to have fallen when at work five years before. There was one case of a man with swollen testicles. There was one case of a woman with a violent headache and swelling of the head, neck, ears, and face. She also had fever. She had a pain in the heart as the head throbbed and "blood rose." No doctor was called; instead she went to see a *kitōshi*. There was one case of a woman (teacher of the flower arrangement class) who was taking special shots during menopause. They were supposed to renew menstruation and rejuvenate. The woman said these were made of horse urine (hormones?).

Warts may be removed by surgery. There is a belief that a wart at the corner of the eye of a woman means that she will lose her husband early. If it is under the left eye, one will lose a girl child; if under the right eye, a boy child.

Some home remedies include the following:

Various herbal remedies are common. The herbs may be purchased from dealers in towns or from itinerants and are usually boiled up into some infusion which is taken internally. *Tōfu* liquid is said to be good for the heart and is drunk by some. Fresh-water snails (*binna*) from paddies are said to be good for swellings and muscle strains. *Yamagobō* is a root boiled in water said to be good for the cure of kidney diseases. It induces urine and is also used to cure syphilis. Pumpkin taken in January is a preventive against paralysis and sickness for the coming year. Juice in which plums are pickled is good for the stomach. The white of egg mixed with *mugi*[12] is said to be good for boils. *Mugi* relieves the fever and the egg takes out the pus. (One man makes this and gives it to friends.)

Milk is regarded as a medicine and is taken (boiled) on doctor's prescription. The people do not like it—"It smells."

One man with a blister on his leg took a needle with a heavy thread and dipped it in a pool of water, then rubbed it against some soot on a pot, stuck the needle through the blister, thus letting out the water and leaving a black smudge. There is perhaps a sort of logic to his actions. Antiseptic is liquid—water is liquid and used for washing, hence dipping the needle in water. A flame is used to purify a needle, leaving soot on the needle, hence the application of the needle to the soot of the pot.

MEDICINE AND DOCTORS VERSUS HEALING PRIESTS

Faith is put in home remedies and healing priests partly because doctors are expensive and difficult to get and often are supercilious in their treatment of rural patients. A good example of an individual farmer's appeal to both doctor and *kitōshi* is seen in the following case:

> The other day Muchan (farmer T's small girl child, aged 3) got very sick. She must have eaten something. In the morning the mother gave her an enema, later they sent for a doctor. Dr. K of Fukada was too busy (someone saw his car here, but the story is he had to go somewhere else). Dr. F from Taragi was called and arrived at six as against three, as promised. He had to attend a soldier's going away party. Dirty and sloppy when he arrived. Wore military boots and cape. Talked in an arrogant tone to farmers, "Who is coming with me to fetch medicine?" "Oh, you are—then take this" handing over his brief case. He decided the baby was all right—poured down her throat a bottle of castor oil then told them to fill the bottle with water and made her drink that (boiling the water he never mentioned). Everyone around marvelled "what, taking oil without sugar!"
>
> Prescribed two medicines—a powder and a mixture and left. He did take her temperature. Did not wash hands before seeing the patient, but demanded water after. While he was there, Mr. M came with a pain in his rump and asked for an injection. The doctor picked out a likely needle

[12] A generic term for barley, wheat, oats, and rye.

and dipped it in ether, but to open the glass capsule he used his dirty scarf. The man stretched out and got the injection.

By nine Muchan's temperature went to 104. Ice packs were on her head. The baby drank water constantly. Mrs. K (a neighbor) came and told the people they should go "kami sama mairi"[13] and I think referred to Kannon sama, but Kyoko san (the mother) went upstairs. (Later Mrs. K who loves to make fun was relating the story to some neighbors—how they urged each other to go and pray and had not thought of it at first. "People never think of doing it until the person is dead".)

When the child started having convulsions, they sent their nit-wit assistant to Yunoharu to call the "Yonoharu oji san" who came later. He is deaf and toothless. He has an *ofuda*[14] which he has used for the last 40 years. He mutters incantations and puts the *ofuda* on the patient's chest—then "something leaves the body" and the patient is relieved. The man came at ten and administered a prayer, was to give another one three hours later, but the baby had more convulsions at twelve, so he was urged to pray. T had great faith in him, and each time the baby shuddered in her sleep he would say "Ji san what is it?" and the old man would say "that is all right." They felt the child was better after the treatment. They were afraid because their first child had died. After the second fit at twelve the child quieted down and toward morning was better. When I came at seven they were having rice and beans for breakfast. The Yunoharu man and the old man from Tontokoro stayed all night. S was there until late. Mrs. K and Mrs. S were the only women who called. No one seems to know what sort of a sect the old man belongs to. "Donna kami sama desho?" they say. By next day the child was all right.

Sickness is a constant hazard in a villager's life. It is something that is unpredictable and dangerous in addition to the pain and suffering involved. There is also an economic loss suffered. People the world over, when faced with something they do not understand and something that can affect their lives seriously, turn to supernatural means in an effort to gain some control over it. Hence, the appeal of T to a healing priest in an effort to gain some control over the illness of his daughter.

MEDICINE AND MAGIC

Many of the medicines and home remedies used in the village are, by modern medical standards, simply so much magic. However, there is a logic behind them, much the same logic we use in taking vitamin pills and other medicine on the recommendation of the doctor. We have no way of telling whether what we are being told to take is good for us but must depend upon the word of the doctor or druggist, just as the Japanese peasant depends upon the word of the doctor or druggist or *kitōshi*. Many of the home remedies and other cures are perfectly logical attempts to cure the sickness, the error being in the false premises as to the cause of the disease. If one believes that a sickness is due to black magic or witchcraft, then it is perfectly logical to visit a *kitōshi* and ask for some countermagic to overcome the illness. If it is believed that a certain illness is due to bad blood, then a medicine said to purify the blood or clean out the system is a perfectly logical remedy. The general idea of bacteria as a cause of disease is pretty well lacking in the villagers' concept of disease, just as it was lacking in Europe in the highest medical circles prior to the birth of bacteriology.

The beliefs in regard to sickness and health can, however, be shifted from the traditional folkways to those of modern medicine as evidenced by the naïve faith in doctors, "injections," and in the general acceptance of such governmental health regulations as smallpox vaccination and house-cleaning inspections.

ATTITUDES TOWARD ILLNESS

The proper attitude for a Japanese to take regarding illness in talking with a stranger is to belittle it so as not to burden a guest with his personal worries and anxieties. However, within the family and among friends, grief may be shown. Among rural people the inhibitions are fewer in this regard, and relatives may show their anxiety more freely than among the more inhibited upper classes.

Sometimes in an effort to console themselves, people will resort to a sort of fatalism, laying their misfortunes to decisions made in heaven or by the gods (*kamisama*).

[13] To visit and pray to deities.
[14] Paper talisman.

Table 1.—List of Deaths over One Year Period (1935)
(Population of Mura 1,663 persons)

Sex	Age	Cause of Death	Day of Death
Male.......	72	Cold (*kambō*)	January 15
Female.....	1 day	Unnatural death (*henshi*) (actually this was a case of infanticide)	February 5
Male.......	77	Uremia (*Nyōdokushō*)	March 16
Female.....	69	Cerebral hemorrhage (*Nōshukketsu*)	March 21
Male.......	56	Apoplexy (*Nōikketsu*)	March 31
Female.....	23	Pulmonary tuberculosis (*Haikekkaku*)	April 1
Male.......	67	Apoplexy (*Nōikketsu*)	April 20
Male.......	60	Apoplexy (*Nōikketsu*)	April 29
Female.....	11 days	Pneumonia (*Haien*)	May 31
Male.......	67	Cerebral hemorrhage (*Nōshukketsu*)	June 4
Male.......	64	Incomplete closing of mitral valve (*Sōbōbenfuzenhei*)	July 15
Female.....	5 days	Premature birth	July 17
Male.......	58	Apoplexy (*Nōikketsu*)	August 9
Female.....	49 days	Heart convulsion (*Shinzōkeiren*)	August 20
Female.....	22	Pneumonia (*Haien*)	August 26
Male.......	66	Apoplexy (*Nōikketsu*)	August 29
Male.......	62	Appendicitis (*Mōchōen*)	September 6
Female.....	6	Acute brain fever (*Kyūsei nōmakuen*)	September 6
Male.......	65	Cerebral hemorrhage (*Nōshukketsu*)	September 15
Female.....	2	Acute gastroenteritis (*Kyūsei ichōkataru*)	September 16
Female.....	68	Asthma (*Zensoku*)	September 17
Female.....	1	Pneumonia (*Haien*)	October 10
Female.....	70	Cerebral hemorrhage (*Nōshukketsu*)	November 10
Male.......	4 mos.	Pneumonia (*Haien*)	November 13
Female.....	54	Apoplexy (*Nōikketsu*)	December 4
Female.....	71	Chronic nephritis (*Mansei jinzōen*)	December 27
Female.....	51	Apoplexy (*Nōikketsu*)	December 30

LINGUISTICS.—*A new method of transliterating Russian.*[1] John P. Harrington, Bureau of American Ethnology.

Systems of writing Russian in the letters of the Latin alphabet have been noningenious and without exception very much bound to earlier usage. There are several such systems, each one of them standard within a certain horizon, all of them reaching to specials and to diacriticals. Almost every book for learning Russian has a different method of transcription. The usual systems go beyond the mere turning of the letters of the Russian alphabet into equivalents; they write the variants that characterize the pronunciation of Russian and that more practically remain unwritten with a coverage of general pronunciational rules. The fundamental fault with the average system of transliterating Russian is that it follows the Polish manner of writing, evaluating y as a vowel and thus losing it as a consonant. English, French, Spanish, and Hungarian employ y as a consonant.

The system about to be presented hinges upon the employment of y as a consonant, and with this employment all other equivalences are made to fall into line. The system has in it vast possibilities, not only for the practical transliterating of proper names, but for the romanization of the Russian language and the doing away with the present Greek-based alphabet, thus following the course already taken by Maltese Arabic, Rumanian, Turkish, and Kurdish. The new method is so simple that it can be set in any printing office or punched out on any typewriter, for it uses no special characters of diacritical marks whatsoever yet is adequate to the sharpest scrutiny of the expert phonetician. The system was long and thoroughly actually used in writing

[1] Received February 19, 1944.

field notes in Russian and was found to be quicker and simpler than the use of the Russian alphabet for one accustomed to the Latin alphabetic character of western Europe. That in the eventual future a Greek-based would supplant the actually scientifically superior Latin-based alphabet of western Europe is unthinkable. It is also unthinkable that in the eventual future there would be two different and rival alphabets.

The method is based on the three fundamental principles:

1. Any system to be practical must be based on the so-called Cyrillic alphabet in which the Russian language is at present standardly written; in other words, the system must be a transliteration.

2. Any system to be practical in an ordinarily equipped printing office and on an ordinary typewriter must be without specials and diacriticals.

3. Any system to be practical must be anchored to the conservative values of letters and must possess rigid conformity within itself.

Carrying out of the first principle means that the well-known inconsistencies in Russian orthography have to be followed in transliteration. Thus we have shity, to sew, despite the actual pronunciation shjty; zhity, to live, despite the actual pronunciation zhjty. Both i and j occur after ts, though the pronunciation is always j. Thus tsirk, circus, though pronounced tsjrk.

The new system is better than the Russian, alias Cyrillic, system, in that it has fewer strokes, it is easier to read, and does not require the learning of, or special equipment for, an alphabet which is not Latin. The Russian alphabet in its printed and typewritten form is noted for the lack of ascenders and descenders, the letters having compact, rectangular shape, optically disadvantageous according to tests of psychology. For instance, the Russian form of l is disadvantageous in not shooting above the body line, as it is called in the printing trade. The Russian letters, most of them, resemble monotonous blocks which demand scrutiny, having the form of Latin small capitals, whereas Latin type has ascending and descending offshoots which serve as eye-catching signals of identification, being in this feature psychologically superior to a larger face of type.

Native newspapers and vast literature in languages of South Africa, which have no unusual letters or marks, gave the hint that Russian also can be thus written and printed in Latin letters, it being necessary only to clear the ground by boldly doing away with the Polish value of y, a value that has long lurked to prevent advancement.

It would seem that the system for Russian here suggested cannot be opposed on just grounds, since it consists merely of a making more scientific, simple, regular, and legible the present Greek-based system. It is hoped that it can be used not only for the romanized appearing of Russian geographical names, and the like, but also for the endemic writing of Russian.

THE NEW SYSTEM

Vowels

a o u e i j

The vowels are short only, but an accented vowel can be pronounced long. There are no true diphthongs, all diphthongs being of the sort exemplified by aw ay.

Consonants

Dorsal: k g ç
Retromedial: y
Frontal: t d sh ch zh s ts z r l n
Labial: p b f v m

Consonants are iotized before e or i of the same word, and this iotization is a blanket rule and is therefore not written in the system. Otherwise iotization is written by postplaced y. Etymofinal voiced consonants are unvoiced in pause, just as in German, not being voiced as they are in modern Scandinavian or in English.

For illustrating the new system one cannot do better than to give lines of poetry, since the iambic beat in the following shows the fall of the unwritten accent. Prosaic accent in the following poem is violated only by the word mirj, universes, which in prose would have the accent on the first syllable:

Ya	*v*	*etot*	*mir*	*prishol*	*chtob*	*videty*	*sontse*
I	into	this	world	came	in order	to see	the sun

I	*sinjy*	*krugozor,*
And	the blue	horizon,

Ya	*v*	*etot*	*mir*	*prishol*	*chtob*	*videty*	*sontse*
I	into	this	world	came	in order	to see	the sun

I	*vjsi*	*gor.*
And	the heights	of mountains.

Ya	*v*	*etot*	*mir*	*prishol*	*chtob*	*videty*	*more*
I	into	this	world	came	in order	to see	the sea

I	*slavnjy*	*tsvet*	*dolin—*
And	the glorious	color	of the valleys—

Ya	*zaklyuchil*	*mirj*	*v*	*yedinom*	*vzore.*
I	embraced	the universes	in	one	glance.

Ya	*vlastelin.*
I	the master.

Ya	*pobedil*	*çolodnoye*	*zabveniye*
I	conquered	cold	oblivion

Sozdav	*mechtu*	*moyu,*
Having created	fancy	my,

I	*kazhdjy*	*mnig*	*bjl*	*polen*	*otkrjteniya.*
And	every	moment	was	full	of revelation.

Vsegda	*poyu.*
Continually	I sing.

GEOCHEMISTRY.—*The formation of colloid from halloysite in dilute acid solutions.*[1] P. G. Nutting, U. S. Geological Survey.

Intensive soil research of the past few decades has clearly shown the presence in most soils of complex mineral aggregates of siliceous colloids. These aggregates may be either massive, in a filterable clear solution, or coatings on microscopic grains; they may be sol, hydrosol, gel, or solid. They form definite associations with the ions of a solution as reported by Sante Mattson and others in numerous papers in Soil Science. The writer[2,3,4,5] has reported a number of studies of relations between dilute acids and clays of the montmorillonite type. Abundant evidence was found for the formation of considerable quantities of stable colloidal hydrosols as well as of salts in dilute acid solutions. To obtain exact quantitative relations between the amount of sol formed and the amounts of acid, clay, and water present, work was continued with the simpler clay minerals kaolinite, halloysite, and allophane under carefully controlled conditions. The allophane available (from Hillsboro, Ohio) reached equilibrium in a few hours but contained 3.5 percent CaO and some iron. The kaolinite, from Bishop, Calif., was very pure but required five days at 96° C. to approach equilibrium.

The halloysite used, from Anamosa, Iowa, contained no detectable Ca, Fe, or Mg. It was room dried and ground to pass a 150-mesh sieve (0.1 mm). As used it contained SiO_2 42.45, Al_2O_3 36.02, H_2O 21.53, or

[1] Received January 11, 1944.

[2] *The action of some aqueous solutions on clays of the montmorillonite group.* U. S. Geol. Surv. Prof. Paper 197-F. 1943.

[3] *Time and temperature effects in the formation of colloidal dispersions.* Journ. Washington Acad. Sci. **31**: 41–45. Feb. 15, 1941.

[4] *A study of the association of magnesia with silica in a pure magnesium clay.* Journ. Washington Acad. Sci. **30**: 233–237. June 15, 1940.

[5] *A study of bleach clay solubility.* Journ. Franklin Inst. **224**: 339–362. Sept. 1937.

$Al_2O_3 \cdot 2SiO_2 \cdot 3.4H_2O$. The alumina was completely soluble in a few hours in 20 percent acid. Special tests showed that 72 hours at 96° in 0.1 percent acid gave a close approach to equilibrium, while at 30° six months would have been required[6] for each run. The relations between the amount of sol and the amounts of clay, acid, and water are, of course, very different at the two temperatures, but apparently only the constants of the reaction equation are affected.

Preliminary runs showed that the center of interest is sufficient acid to dissolve the alumina (0.75 gram HCl per gram of halloysite) in sufficient water to dissolve the silica (1 liter per gram of clay), or a gram of clay in a liter of 0.075 percent HCl. Preparations were made with $\frac{1}{2}$, 1, and 2 times these amounts of clay, acid, and water, 27 in all (or 19 excluding simple multiples) which were analyzed.

After 72 hours at $96° \pm 1°$, the last 16 hours without stirring, the clear liquor was decanted with an aspirator flask and the undissolved clay filtered, washed, ignited and weighed. A few ml of the decanted liquor was cooled for *p*H determinations. Each solution was evaporated and the residue, heated to 160° for an hour to remove free acid and moisture without disturbing OH, and then weighed. Each residue was then boiled 10 minutes in 150 ml of distilled water to remove possible chlorides, again dried at 160° and weighed. Silica and alumina were then separated by a ten minute digestion in about 20 ml of hot 20 percent HCl. Repeated runs gave results duplicating within 2 percent.

Undissolved clay residues varied between 22.9 percent for clay:acid:water$=\frac{1}{2}:1:\frac{1}{2}$ to 91.7 percent for $2:\frac{1}{2}:2$. In composition, they differed but little from the original halloysite. The *p*H of the solutions varied chiefly with the clay:acid ratio, 2.5 for original clay:acid$=2:1$ to *p*H 1.5 for clay:acid$=1:2$. It varies little with the water present, by about 0.02 for half or double the amount of water; hence both the dissociation and hydrolysis of reaction products are but little affected by the amount of water present in this range.

Residues from evaporation of solutions varied from 0.125 to 0.709 gram per gram of clay, the chief factor being the ratio of acid to clay. In each of the nine sets of observations in which the clay:acid ratio was constant, the amount of residue decreased by one-third as the water alone varied from $\frac{1}{2}$ to 2 liters.

The hot-water extract of the solution residue (150 ml) always caused a loss in weight averaging 20 percent, both weighings following thorough drying at 160°. This extract was neutral to litmus and added ammonia gave no precipitate except in two cases of high acid:clay ratio, hence was free from acid and aluminum chloride. Analysis showed it to be an alumino-silicate hydrosol with an alumina:silica ratio of about 1:1.5 (molar). The solution residue not dissolved by 150 ml of hot water varied from 0.056 to 0.734 gram per gram of original clay as acid varied from $\frac{1}{4}$ to 4 normal ("normal" is 0.75 gram HCl). With clay:acid 1:1, it decreased from 0.375 with water $\frac{1}{4}$ to 0.151 gram for water$=4$ liters per gram. An average of the 19 analyses (27 combinations) gave $SiO_2:Al_2O_3=0.88$, close to that for $2Al_2O_3 \cdot 3SiO_2$ (0.884). This ratio varies slightly with the ratio of acid to clay; extremes were 1.1 for acid:clay$=4$ and 0.7 for acid:clay$=1:4$. The average composition of the washed residue at 160° is SiO_2 34.8, Al_2O_3 40.0, H_2O 25.2 percent or very close to $2Al_2O_3 \cdot 3SiO_2 \cdot 7H_2O$, an allophane. Similar runs but less extensive and less exact, made with kaolinite, mica, and allophane instead of halloysite, gave the same allophane hydrosol.

The amount of sol (S) produced, time 72 hours and temperature 96° being constant, depends upon the three independent variables clay (C), acid (A), and water (W). Mere inspection of the 19 analyses yields only the qualitative summary given above. To obtain exact reaction equations between sol, clay, acid, and water, the 27 analyses were plotted in various sets of graphs. In each set, one factor (say clay$=1$ gram) is constant throughout, another (say water) is the parameter, constant in each group while the third is the chief variable, the object being to discover linear relationships, if any, between these variables. Three such relations were found:

[6] *Op. cit.*, footnote 3.

Sol: Acid, clay, and water constant, acid variable.
Log (S:A) linear in log C, water constant.
Log (S:A) linear in log W, clay constant.

These three relations may be combined in

$$\text{Log S} = \log \text{A} + a \log \text{C} + b \log \text{W} + \text{const.}$$

With this as a guide the 27 analyses were written as 27 equations which were solved by least square methods to obtain values of the constants. Using natural logarithms the final relation is

$$\text{Log S} = \log \text{A} + 0.322 \log \text{C} - 0.318 \log \text{W} - 1.421$$

for grams of sol formed where pure halloysite is brought to equilibrum with dilute hydrochloric acid solutions at 96°. This relation holds for acid:clay ratios below 1:4 (by weight) up to about 4:1 above which free chlorides are formed. All constants depend upon temperature. The clay is in grams, the water in liters, and the acid in multiples of 0.75 gram. For $C=1=W$, $S=0.24$ A, or 75 $S=A$ in molar proportions, if the molecular weight of the sol is 510, indicating that the acid is used many times over. Water and clay are evidently in competition for the acid.

The chemical processes involved appear to be very simple. After the clay has adsorbed sufficient anions it is attacked by them. Free silica and chlorides go into solution and the chlorides are hydrolyzed, alumina combining with the silica to form a sol while the free acid returns to the clay to form more chloride. This process continues until the potential of the accumulated sol is balanced by that of the clay. This balance is at somewhat less than half the clay because the halloysite has some structural energy while the sol has little or none.

SUMMARY

Halloysite in warm dilute acid forms a sol having the composition of allophane $2Al_2O_3 \cdot 3SiO_2 \cdot 7H_2O$ after drying at 160° C., over an intermediate range of clay and acid concentrations.

A quantitative relation between sol formed and the acid, clay, and water used is obtained from experimental data covering the range from just sufficient acid to dissolve the alumina and water to dissolve the silica, to half and double these amounts.

At equilibrium, the clay solution contains free acid (*p*H 1.5 to 2.5) but no salt other than the sol in this range.

With clay and water as parameters, the amount of sol formed is in a fixed ratio to the acid present.

With acid and water as parameters, the sol varies with about the cube root of the clay present, indicating a reversible reaction.

The amount of sol varies inversely with the water present, clay and water competing for the acid present.

After oven drying at 160°, the sol (then gel) is soluble in hot water to the extent of about 0.3 gram per liter, slightly less than than silica gel, 0.4 gram per liter.

A general characteristic relation is deduced between amount of colloid formed and the amount of acid, clay, and water present. In reference 3, p. 45, it was shown that silica, alumina, acid, fluorides, and other salts added to the sol solution were without effect on the colloid formed. Variations with temperature and the nature of the acid remain to be investigated.

ECOLOGY.—*An analysis of the flora of the Bull Run Mountain region of Virginia using Raunkiaer's "life-form" method.*[1] H. A. ALLARD, Bureau of Plant Industry, Soils, and Agricultural Engineering.

INTRODUCTION

Ecologists have long been aware of the intimate relations between plant life and climate and, rightly regarding vegetation as an expression of the climatic complex, have attempted to devise methods to express this concretely and statistically in terms of plant life itself. Long ago Humboldt (*Physiognomik der Gewächse,* 1806) attempted to classify vegetation on something of an ecological basis. Griesbach (1872) and others building upon these concepts recognized

[1] Received November 6, 1943.

the intimate relation between the forms of plants and climate. Among these were Kerner (1863), Warming (1909), and Drude (1913). Such classifications as were recommended ignored taxonomic relationships since it is obvious that the ecological relations of plant life do not depend upon taxonomic concepts. Finally in 1908, a Dane, C. Raunkiaer, published a fundamental paper on life-forms and statistical methods.

Raunkiaer's method was unique in that it considered the plant to be a concrete, living expression not of one factor alone, but of the entire climatic complex, including temperature, humidity, and the water relations of the soil. The basis of his method, naturally, was the final adaptation of the plant, and the special feature selected by him related to the critical or unfavorable season, as indicted by the degree and kind of protection which enabled the plants to survive this in a particular region. This, it is obvious, was concerned mainly with the perennating buds, formed above or below ground in the case of perennials. While this concept does not afford a perfect measure of climate it has appealed to many plant ecologists as one of the best systems yet devised, since the plant itself has been chosen to represent its own success and survival in a given region.

LIFE-FORM SYSTEM OF RAUNKIAER

Raunkiaer in 1908 finally carefully selected and classified 400 representative plants from the world's flora, and used these to establish a provisional biological spectrum for the world, which he considered to be a standard for comparison. In 1916 he extended his studies to include the remaining 600 species, which he had originally chosen to represent his normal world spectrum. While there were only minor differences in the calculations for the two groups, Raunkiaer's spectrum based upon his final figures for 1,000 selected plants has been used in the present discussion.

His method requires a classification of all the Spermatophyta of a regional flora into five main groups, some of which are subdivided into smaller groups. These are listed as follows, with abbreviations:

PHANEROPHYTES—Ph.—Branching woody plants, with their dormant buds wholly exposed to the air. These are further classified according to size into the following subgroups: (1) megaphanerophytes—Mg.—having a stature over 30 meters (98 feet); (2) mesophanerophytes—Ms.—with a stature of 8–30 meters (26 to 98 feet); (3) microphanerophytes—M.—2–8 meters tall (6–26 feet); nanerophytes—N.—under 2 meters tall ($6\frac{1}{2}$ feet).

CHAMAEPHYTES—Ch.—Plants with their dormant buds on the surface of the ground or just above it, not more than 25 cm. (10 inches). These are protected by snows in winter in colder regions, or by the plant remains in dry or warmer regions.

HEMICRYPTOPHYTES—H.—Plants with their buds in the upper layer of the soil, near the surface, the aerial portions dying away in the unfavorable season further protecting these subterranean buds.

CRYPTOPHYTES.—Plants with their dormant structures entirely buried more or less deeply below the soil surface. This class has been subdivided as follows: Geophytes—G.—with bulbs tubers, rhizomes deep below the soil surface; Helophytes—Hl.—certain marsh plants growing chiefly in saturated soil or in water, from which the flower-bearing shoots emerge. Their buds are buried at the bottom of the water or in the muddy soil.

HYDROPHYTES—Hy.—Water plants with their perennating structures beneath the water.

THEROPHYTES—Th.—Annuals living only for the season.

Classification of plants into these various groups requires a little care, for certain plants may seem to fall rather doubtfully into a given class. As a rule, however, it is not difficult to attain this objective, and a few doubtful cases change the final percentages very little. Some of the Hemicryptophytes and Cryptophytes have been less readily distinguished for this reason. Plants were considered to belong to the former class when their dormant buds were not deeper than 1 inch in the soil.

RELATIVE PROPORTIONS OF WOODY AND HERBACEOUS PLANTS IN DIFFERENT REGIONS

In temperate, humid regions the relative proportion of woody plants and herbs tends to be rather constant, as indicated by the following figures, which have been deter-

mined by Sinnott and Bailey (1914). Unfortunately these figures apply to the Dicotyledoneae alone, however. Inclusion of the Monocotyledoneae would decrease the proportion of woody plants and increase the proportion of herbs materially.

In the northern United States (Britton and Brown) woody plants constitute 22 percent of the Dicotyledoneae, and herbaceous 78 percent; northeastern United States (Gray), woody plants 23 percent, herbaceous 77 percent (Dicotyledoneae); including all Angiosperms in Gray's Manual (4,079 species), the figures become 14 percent woody, 85.9 percent herbaceous; Great Britain (Hooker), woody 11 percent, herbaceous 89 percent; Russian Empire (Ledebour), woody 14 percent, herbaceous 86 percent; France (Cusin and Ansberque), woody 11 percent, herbaceous 89 percent; Norway (Blytt), woody 14 percent, herbaceous 86 percent; Flora Orientalis (Boissier), woody 17 percent, herbaceous 83 percent; Spain (Lázaro é Ibiza) woody 21 percent, herbaceous 79 percent. All the above figures, unless otherwise stated, refer to the Dicotyledoneae alone.

Within the United States Deam (including all Spermatophyta) lists 2,568 species for Indiana, 14.4 percent being woody, 85.5 percent herbaceous. Ennis (1928) for Connecticut lists 1,453 native species, of which 15.06 percent are woody and 84.9 percent herbaceous. In the relatively very small Bull Run area (including all Spermatophyta) 18.2 percent are woody, 81.8 percent herbaceous.

It is well known that the percentage of woody plants, trees and shrubs in humid regions increases as one approaches the warmer tropical latitudes. These relations are clearly shown in the following figures based upon the Dicotyledoneae alone: Florida Keys (Small), 46 percent are woody plants, 54 percent herbaceous; Japan (Matsumura), 43 percent woody, 57 percent herbaceous; Brazil (Mueller), 74 percent woody, 26 percent herbaceous; Amazon Valley only, 88 percent woody, 12 percent herbaceous; Malay Peninsula (King), 83 percent woody, 17 percent herbaceous; Philippines (Merrill), 68 percent woody, 32 percent herbaceous; Dutch East Indies (Koorders), 75 percent woody, 25 percent herbaceous.

Comparisons of these figures especially for the humid, temperate regions favorable to forest indicate the common pattern of the vegetation in its ecological aspects. This is true whether one considers the relatively small Bull Run area, the State of Indiana, large portions of the United States (Gray, etc.), Great Britain, or Italy. If the floristics of the primeval vegetation which formerly existed in all these regions could be known it is probable that even greater uniformity of ecological structure would be established. These uniformities appear to represent fundamental floristic and structural relations of the vegetation for the countries in question. However, if plant life, as it now exists, and as Raunkiaer has assumed, is a dependable, concrete measure of the climatic complex, such fundamental relations should obtain. There are probably greater differences existent in the species composition of the vegetation of the several regional floras mentioned than in the life-forms that make up ecological structure of these.

BIOLOGICAL SPECTRUM OF THE FLORA OF BULL RUN MOUNTAIN

A comparison of the biological spectrum of the Bull Run area with Raunkiaer's normal spectrum is presented in Table 1. The data for the Bull Run area are based mainly upon the list of plants recently reported upon by Allard and Leonard (1943). In this paper 1,010 different plants were recognized, 8 other plants (not yet added in print) being found in 1943, bringing the total to 1,018 plants.

The data of Table 1, all of which refer to the Bull Run area aside from Raunkiaer's spectrum, are of some interest. Some workers have been careful to make use of only the native Spermatophyta in the calculation of a biological spectrum for their region. A comparison of the spectra for all the native and introduced Spermatophyta and for the native Spermatophyta alone reveals striking agreement, however. The data for the native Dicotyledoneae alone also show only slight departure from these values.

Table 1.—Percentage Occurrence of Life-Forms in the Normal Spectrum of Raunkiaer and the Vegetation of the Bull Run Region

Spectrum	Total flora	Occurrence (percent)									
		Th	Ch	H	G	Mg	Ms	M	N	Hl	Hy
Raunkiaer's normal	1000	13	9	26	4		8[1]	18	15		2[2]
All Spermatophyta, native and introduced	980	17.0	1.4	51.7	9.1	1.8	6.4	5.6	4.4	1.4	.8
All native Spermatophyta	847	15.1	1.6	50.4	9.8	1.8	6.3	5.5	4.7	1.6	.8
All native Dicotyledoneae	616	15.9	2.2	48.3	7.3	2.6	8.7	7.1	6.4	.4	.6
All native Monocotyledoneae	224	13.4	—	62.0	16.9	—	—	1.3	—	4.8	1.3
All introduced Dicotyledoneae	108	32.4	—	50.9	.9	—	5.5	5.5	3.7	1.4	.8
All introduced Monocotyledoneae	25	16.0	—	60.0	24.0	—	—	—	—	—	—
All native Spermatophyta in primitive wooded areas	446	3.3	1.3	52.9	12.1	4.0	10.4	8.0	4.9	1.7	.8
All native Spermatophyta in fields, pastures, or cleared or cultivated areas	402	28.1	1.9	50.0	7.2	—	2.4	3.4	4.4	—	2.2

[1] Mg + Ms.
[2] Hl + Hy.

Comparison with Raunkiaer's normal spectrum reveals certain departures for some classes. Considering all native and introduced Spermatophyta, the greatest departure is shown for the Hemicryptophytes (H), which in the Bull Run flora have been determined to be 51.7 percent as compared with the normal spectrum of 26 percent. Since depth of the dormant buds serves to distinguish the Hemicryptophytes from the terrestrial Cryptophytes (G), one may expect some degree of error to appear here in deciding into which class a certain plant should fall. If, however, a summation of the Hemicryptophytes (H) and Cryptophytes (G) is made (the number of Helophytes (Hl) and Hydrophytes (Hy) is too small to affect the results materially), one obtains 30 percent for the normal spectrum and 60.8 percent for the Bull Run spectrum. These striking differences indicate a climate in the Bull Run area highly favorable to Hemicryptophytes and Cryptophytes, plants that are adapted to withstand a cold, dormant season of considerable severity such as the higher temperate latitudes experience.

The biological spectrum for all introduced Dicotyledoneae of Bull Run Mountain agrees closely with that shown for all the Spermatophyta of the area, except in the proportion of Therophytes (T) representing the annuals. This has increased from 17 percent for the latter to 32.4 percent for the former. Since field conditions offer a more favorable habitat for this class, as most introduced plants cannot compete with the vegetation of forest areas, this relationship is the natural one.

The spectra of all native Spermatophyta found in wooded, primitive areas, and also in fields, pastures, or cleared and cultivated areas has also been presented. The differences shown in some of these groups are of significance. It will be noted that the annuals or Therophytes (T) in the more primitive woodland areas represent only 3 percent of the plants, while in cleared and cultivated areas the figure has become 28.1 percent. Hemicryptophytes (H) and Cryptophytes (G) in the more stabilized woodland make up 65 percent of the flora, and only 57.2 percent in the cleared areas. Since there is a progression from annual to perennial types in the early successional stages, and the climate favors an abundant hemicryptophytic and cryptophytic element, an increase in this class of plants is a natural condition as woodland prevails. The herbaceous element in the woodland areas is 72.1 percent, and 89.4 percent in the cleared areas. This too is a correct reflection of actual differences in the vegetation in the two habitats, since the herbaceous element is predominant in the early stages of succession where the forest has been entirely destroyed. The woody element of the cleared areas is only 10.2 percent, compared with 27.3 percent in the more natural woodland areas. Immediately following abandonment from cultivation, the woody element may be almost entirely lacking, but various weedy trees and a variety of shrubs make their appearance in older fields and pastures

until a closed overstory of trees has captured the area. The statistical differences in the life-forms of the two areas plainly emphasize the pioneer successional nature of the old field assemblage in its trend toward woodland. If the field and pasture areas were selected on the basis of age from time of abandonment, the woody element would be found to increase with corresponding decrease in the herbaceous element until the stability of climax conditions between trees and herbs had been attained.

SIMILARITY IN THE SPECTRUM OF THE FLORA OF BULL RUN MOUNTAIN AND THAT OF SOME OTHER EASTERN AREAS

Summarizing the woody elements as represented by Mg, Ms, M, and N, we have 41 percent for the normal spectrum, 18.2 percent for all Bull Run Spermatophyta, and 15.1 percent for all native Spermatophyta of the Bull Run area. If one considers the average for the Dicotyledoneae as listed in the floras of Gray, and Britton and Brown, for the northern and northeastern United States, Small's southeastern flora, Chapman's southern flora, Coulter for the Rocky Mountains, together with the floras of Great Britain, France, Germany, Switzerland, the Russian Empire, Norway, Spain, Syria and the Orient, the woody element amounts to 17.4 percent, and the herbaceous element 82.6 percent. For the Bull Run region the woody element becomes 18.2 percent and the herbaceous becomes 81.9 percent for all native and introduced Spermatophyta. The woody and herbaceous elements of the native and introduced Dicotyledoneae of the Bull Run Mountain area amount of 24.3 percent and 75.7 percent, respectively. The latter figure for the herbaceous element occurring in the Bull Run Mountain area is much higher than 54 percent which has been taken to represent the herbaceous element for the normal spectrum of the world flora. This figure for the herbaceous element falls below that of any temperate region of North America, Europe, or Asia. It very closely approaches the dicotyledonous herbaceous element of floras found in warm areas; namely, 54 percent for the Florida Keys (Small), 57 percent for Japan (Matsumura), and 54 percent for the Upper Gangetic Plain (Duthie), where the phanerophytic or woody component is high. The high herbaceous element occurring in the Bull Run Mountain area indicates a regime of north temperate climate considerably removed from that of warm, humid latitudes.

Taylor (1915) (1918) determined the growth forms for the vegetation of New York City and vicinity, and the total flora of Long Island, N. Y., on the basis of Raunkiaer's concepts. Ennis (1928) did a similar and very excellent piece of work for Connecticut. This work is of particular interest when compared with the percentage composition of the growth forms of all Spermatophyta of the Bull Run area, owing to the close agreement in the two areas as shown by the data in Table 2.

TABLE 2.—PERCENTAGE OCCURRENCE OF LIFE-FORMS IN THE SPERMATOPHYTA FLORA OF THE VICINITY OF NEW YORK CITY; OF LONG ISLAND, N. Y.; CONNECTICUT; THE BULL RUN AREA; INDIANA; AND THE NORTHERN AND EASTERN UNITED STATES (Gray)

Spectrum	Total flora	Occurrence (percent)								
		Th	Ch	H	G	Mg	Ms	M	N	Hl+Hy
Vicinity of New York City (native flora)	1907	13.0	5.29	33.29	20.23	.52	4.03	7.18	3.51	11.74
Long Island	719	13.94	5.89	33.15	20.1	.89	4.37	6.34	2.77	10.9
Connecticut (native)	1453	11.7	1.9	49.4	13.2	1.5	3.9	5.8	3.7	8.5
Bull Run region	980	17.0	1.4	51.7	9.1	1.8	6.4	5.6	4.4	2.2
Indiana (Deam)	2420	11.2	1.4	50.9	11.6	1.5	5.08	4.5	3.1	5.7
Gray's Manual (N. & E. U.S.)	4283	15.2	1.4	52.4	10.4	.9	4.1	4.6	4.9	5.6

Total Hemicryptophytes and Cryptophytes (H, G, Hl, Hy). New York City 65.36 percent; Long Island 64.5 percent; Connecticut 71.1 percent; Bull Run 62.0 percent; Indiana 68.4 percent; northern and eastern U. S. (Gray) 68.5 percent.

Woody plants (Mg, Ms, M, N). New York City 15.24 percent; Long Island 14.37 percent; Connecticut 14.9 percent; Bull Run 18.2 percent; Indiana 14.7 percent; northern and eastern U. S. (Gray) 14.7 percent.

Herbaceous plants (Th, Ch, H, G, Hl, Hy). New York City 83.55 percent; Long Island 85.63 percent; Connecticut 84.7 percent; Bull Run 81.8 percent; Indiana 85.3 percent; northern and eastern U. S. (Gray)85.3 percent.

The greatest discrepancies are shown for the Hemicryptophytes (H) and the Cryptophytes (G, Hl, Hy). However, these classes are most readily confused, since little more distinguishes the plants of each than the depth of the dormant buds. It will be noted that the summations, however, give remarkably close total percentages. The summations of all the Phanerophytes or woody plants (Mg, Ms, M, N), and the herbaceous plants (T, Ch, H, G, Hl, Hy) also give very close values. These results indicate that the ecological structure of the vegetation in these four areas is strikingly similar.

PHYSIOGNOMY OF VEGETATION NOT REVEALED BY THE BIOLOGICAL SPECTRUM

Raunkiaer's biological spectrum was devised to serve as a concrete expression of climate in terms of living plants. This has required a reduction of all the climates of the world to an average expression in terms of growth forms, in order that the spectrum would represent a mean concrete expression of the plant life of temperate, cold, and tropical climates. Since very cold and very warm climates have helped to make up this normal spectrum, it must represent some intermediate condition of climatic plant expression so that it can be neither strictly tropical, temperate, nor frigid. It would be exceptional, then, to find a section of our north temperate flora, a frigid or a tropical flora showing exact agreement with this standard spectrum in all respects.

While the Raunkiaer method of analyzing vegetation on the basis of its ecological life-forms may afford a statistical means of evaluating the structure of vegetation of a climatic zone, it does not reveal the physiognomy or visual aspect of such vegetation. It does not indicate whether the dominant vegetation of the climax forest is deciduous, evergreen, coniferous, or broad-leaved evergreen. As Ennis has shown in her discussion of Connecticut spectra, the Coastal Plain areas of the South have the physiognomy, visually, of a coniferous forest due to an overstory of these, but the region is one of deciduous forest in its fundamental trends. In other words, the coniferous aspect is due to other influences than climate, such as determines the great natural coniferous forests of the North, and the higher mountain lands of the Appalachians. These forests at all levels are coniferous in their structure. In the Bull Run area, the deeper, richer soils of the slopes and valleys are given to deciduous forest naturally. The sharp, dry, barren ridge crests carry a permanent thin mantle of several species of pines, which, in some areas noticeably affect the physiognomy of the area.

There is but one broad-leaved evergreen species in the Bull Run area which has any physiognomic significance, and this is confined to the understory entirely. This shrub, *Kalmia latifolia*, completely dominates the understory of extensive areas of the woodland slopes to such an extent that little else can compete with its dense vegetation. In reality this evergreen shrub is the only species normal to the flora of the Bull Run highlands, for *Ilex opaca* and *Phoradendron flavescens* are practically out of their normal range here. Only 10 species of woody evergreen plants occur in this area.

The minor importance of this group in this area compared with the flora of various other areas is shown in Table 3.

Table 3.—Percent of Woody Evergreen Species, Broad-Leaved Evergreen Species, and Evergreen Conifers in the Flora. (Data in part from Ennis, 1928.)

Flora	Species of woody plants	Evergreen species		Broad-leaved evergreens		Evergreen conifers	
		No.	Percent	No.	Percent	No.	Percent
Florida........	357	111	31	98	27.4	13	3.6
District of Columbia....	187	20	10.5	12	6.3	8	4.2
Connecticut...	219	21	10	8	4	13	6
Penobscot Bay.	97	16	16.4	4	4.1	12	12.3
Bull Run region	188	10	1	3	1.5	7	3.7

The data of Table 3 indicate the increased importance of the broad-leaved evergreen plants in Florida, and the minor importance of the evergreen conifers here. This relation is reversed for the Penobscot Bay region where the evergreen conifers become a dominant element of the flora and the broad-leaved evergreens reduced. Although the woody plants of the District of Colum-

bia and the Bull Run area are almost identical in number, with a similar evergreen coniferous content, the broad-leaved evergreens are much more important in the former area.

ADAPTATION OF LIFE-FORMS OF PLANTS IN RELATION TO THE UNFAVORABLE SEASON

While Raunkiaer's classification takes into consideration the adaptation of the various plants to the season most unfavorable to growth, this being the severe winter season in the colder northern latitudes, the relationship is not one of direct cause and effect. As a matter of fact in the case of most of the woody and herbaceous perennials the perennating buds are laid down near midsummer in response to factors of the climate seasonally far removed from the actual cold of wintertime. Whatever these factors may be it is obvious that the plants have been ecologically preconditioned in one way or another to meet the oncoming severe winter conditions at the end of the warm growing season, even though this may have been merely an incidental and not a causal relationship in the life of the plant.

While the factors of humidity, temperature, wind velocity, rainfall, and percentage of sunshine are seasonally extremely variable, one factor, length of day, is an astronomical event recurring with great constancy from year to year. The work of Garner and Allard in 1920 demonstrated that the life-form and life-duration of plants could be profoundly modified by this regular recurring seasonal factor of climate. At the present time the great desideratum in our knowledge of climate in relation to the life-forms of plants is the lack of specific information as to how the climatic complex selectively or adaptively determines the character of the spectrum that will prevail in a particular zone. That there is a fundamental reason why Hemicryptophytes and Cryptophytes are dominant in the flora of the cooler middle latitudes, such as in our humid north temperate zone, cannot be doubted. It cannot be denied that a given flora is adaptively related to a particular climate as Raunkiaer's life-form studies have postulated. Unfortunately, there is little evidence at hand at the present time to explain the mechanism of this seeming adaptiveness. Raunkiaer, as the result of

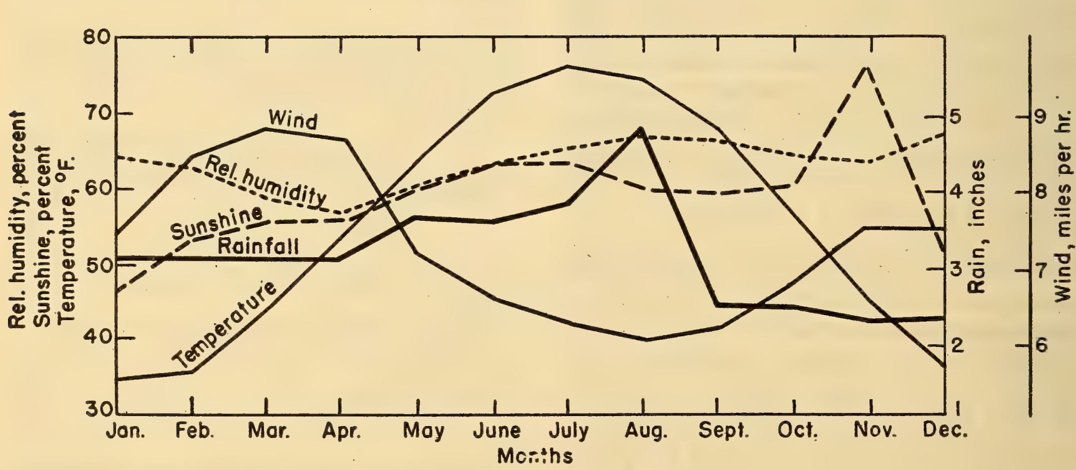

Fig. 1.—Climatic regime for the Bull Run Mountain region, typical of the Hemicryptophyte climate of the Eastern Atlantic States. The normal temperature, humidity, sunshine percentage, wind velocity, and rainfall curves are shown for each month of the year. Rainfall is for nearby Manassas, Va., interpolated for 35 years from about 20 years of records. The temperature curve is the mean of records for Washington, D. C., and Culpeper, Va., which is the nearest weather station recording temperatures. The curves for humidity, wind velocity and sunshine were taken from Washington records. The humidity curve is based upon the mean of the normal minimum and maximum values computed from records of the U. S. Weather Bureau station for 7:30 A. M. and midday, respectively. The figures for temperature also correctly represent the percentages of sunshine and relative humidity.

his fundamental investigations of the life-forms of plants showed that some species can change their characteristic life-form to a greater or less degree. One of these, *Tussilago farfara*, in Denmark is a Cryptophyte, but in milder or more southern latitudes becomes a Hemicryptophyte. This observation has fundamental implications in an interpretation of the dependence and occurrence of life-forms in relation to a particular climate.

CONCLUSIONS

It is obvious that the Bull Run region, like all the eastern portions of the United States, is dominated by a Hemicryptophyte climate. Fig. 1 shows the dominant features of such a climatic regime with respect to normal temperature, relative humidity, rainfall and wind velocity over a long period. Temperature and available moisture are very largely responsible for the general character of the climax forest vegetation of a region. It appears from Fig. 1 that every factor of the climatic complex in our eastern forested region favors the conservation of moisture during the growing season so far as plant life is concerned. As the duration and percentage of sunshine and temperature increase the relative humidity of the air and the rainfall increase, and the mean wind velocity decreases, serving as an additional check upon evaporation at a time when the temperatures are highest. It is thus seen that when the plants are forced into their maximum activity by one set of factors, others operate to counteract any unfavorable tendencies, thus constituting one of the most ideal climates for many types of mesophytic vegetation. This favorable and supplementing interplay of all factors, then, is particularly favorable to a very luxuriant summer vegetation dominated by deciduous forest as the overstory, with a rich Hemicryptophyte flora beneath this forest cover capable of surviving severe conditions, with its enforced dormancy of vegetative activity.

Whatever the significance of Raunkiaer's normal world spectrum, his studies indicate convincingly that the life-forms of plants are so definitely related to a particular climate that the constancy of relationship must be determined or conditioned by the operation of definite climatic laws prevailing under every climatic regime. It must be admitted, also, that his life-form classification, with its statistical aspects, may have genuine ecological meaning in the interpretation of some features of the striking relationships of vegetation everywhere.

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ENTOMOLOGY.—*Concerning Neotropical Tingitidae (Hemiptera).*[1] C. J. Drake and E. J. Hambleton, Iowa State College.

This paper contains the descriptions of 2 new genera, 15 new species, and 1 new variety and notes on a number of other species of lace bugs from Neotropical regions. The specimens were collected largely by the junior author. The types are in the Drake collection.

Subfamily Cantacaderinae

Phatnoma amazonica, n. sp.

Closely allied to *P. marmorata* Champion but readily distinguishable by the nonannulate femora, nearly uniform brownish color, shorter and more ovate form, the apical portion of foliaceous nervure separating discoidal and subcostal areas without a blackened area; costal area also one row of areolae wider; oblique, adventitious nervures of discoidal and subcostal areas much less prominent and not differently colored; head slender. Other characters very similar to *P. marmorata.*

Length, 3.30 mm; width, 1.25 mm.

Type (female), Pará, Brazil.

In *P. marmorata*, the veinlets dividing the areolae of the foliaceous nervures delimiting the discoidal area are infuscate. The entire insect is quite marmorate in general appearance, whereas *amazonica* is almost uniform in color.

Phatnoma marmorata Champion

Known from Panama, Honduras, and Brazil and recorded from the cocoa bean. One specimen from Trinidad, B. W. I., was taken on cultivated pineapple, May 25, 1934, by Dr. A. M. Adamson.

Stenocader, n. gen.

Obovate, more convex above in long- than short-winged form. Head very long, rather broad, tumid above, with two pairs of spines in front of eyes; bucculae long, reticulated, meeting a little before apex of head. Antennae long, slender, smooth; segments I and II short, together not reaching apex of head, the former slightly longer and stouter; III very long, very slender, often longer in male than female; IV rather short, moderately thickened. Rostrum extremely long, extending considerably on base of abdomen; rostral channel distinct, the laminae raised and subparallel, the venter strongly impressed along median line of basal half so as to form a distinct groove for the reception of rostrum. Eyes set close to pronotum.

Pronotum narrowed anteriorly, subtruncate in front, pitted, with five carinae, the outer or lateral pair short, the middle pair interrupted at base of collar, hind margin of pronotum not strongly produced, subtruncate or slightly convex; scutellum small, exposed. Paranota narrow, only slightly reflexed, the outer margin serrate, somewhat toothed. Elytra divided into the usual areas, the discoidal and subcostal areas with raised transverse nervures, the clavus distinct, within meeting in a straight line; elytra more strongly overlapping apically in long- than short-winged form when in repose, much more convex above in short-winged form, the outer margin of costal area granulated or toothed; wings much longer than abdomen in long-winged specimens.

Type of genus, *Piesma tingidoides* Spinola from Chile.

The discoidal area is very long, extending more than three-fourths of the total length of elytra. The males are distinctly slenderer than the females and also have a little longer antennae. *Stenocader* differs from *Nectocader* Drake in not having the elytra very much more widely and abruptly expanded at the base, and the costal area is without a row of large marginal areolae distinctly set off within by a thickened nervure so as to form practically another area. The rostrum is longer in *Nectocader*, and there is no median furrow on base of venter for the rostrum in repose. In the genus *Cantacader* Amyot and Serville, the scutellum is concealed, being covered completely by the hind margin of pronotum.

Stenocader tingidoides (Spinola)

Piesma tingidoides Spinola, *in* Gay, Hist. Chile, Zool. **7**: 200. 1852; Signoret, Ann. Soc. Ent. France, 1863: 575.
Cantacader tingidoides Reed, Rev. Chil. Hist. Nat. **4**: 179. 1902 (reprint, p. 86).
Cantacader? germaini Signoret, Ann. Soc. Ent. France, 1863: 586; Reed, Rev. Chil. Hist. Nat. **4**: 179. 1902 (reprint, p. 86).
Nectocader tingidoides Drake, Iowa State Coll. Journ. Sci. **3**: 42. 1928; Rev. Ent. **10**: 322.

[1] Received December 23, 1943.

1939; Drake and Poor, Iowa State Journ. Sci. **10**: 383. 1936.
Nectocader germaini Drake, Iowa State Coll. Journ. Sci. **3**: 41. 1928.

Many examples from Chile. The longer antennae of male, and the marked difference between long- and short-winged forms, together with color variations account for the above synonymy.

Genus **Eocader** Drake and Hambleton, 1934

Montea Bruner, 1940.

Haplotype, *Eocader vegrandis* Drake and Hambleton.

In this genus the paranota are uni- or triseriate, the lateral carinae sometimes being distinct or more or less obsolete in specimens of the same species. Only two species are known. The genus *Montea* Bruner is identical with *Eocader*. Long- and short-winged specimens of both species have been examined.

Eocader vegrandis Drake and Hambleton

Eocader vegrandis Drake and Hambleton, Rev. Ent. **4**: 436, fig. 1. 1934.

Originally described from a brachypterous female, Viçosa, Minas Geraes, on the fruit of *Bombax monguba* Mart. Zucc., an imported tree; allotype (male) and several other examples taken on mongubeira, Jardin Botanico, Rio de Janeiro, A. A. Silva. The lateral carinae are often wanting or only faintly indicated in apterous individuals.

In a macropterous specimen the lateral carinae are sharply raised, very distinct and scarcely bent inward in front. The elytra are long, extending considerably beyond apex of abdomen, and overlap at apex; the costal area is triseriate in widest part near base and uniseriate distally. The color of the elytra is testaceous, with the nervures bounding discoidal and the oblique adventitious nervelets of subcostal and discoidal areas dark fuscous. The wings are nearly as long as the elytra. The length is 2.55 mm, the width, 1.20 mm.

Subfamily Tingitinae

Monanthia berryi Drake

Through an error and misunderstanding of locality label, this insect was wrongly described from Uruguay. The locality label should read, Chanchaqui, Perú, August 21, 1942, P. A. Berry. Since the original description was published, 10 additional specimens have been received from Perú. Not recorded elsewhere.

Teleonemia lanceolata (Walker)

Monanthia lanceolata Walker, Cat. Hemiptera Brit. Mus. **6**: 194. 1873.
Teleonemia albomarginata Champion, Biol. Centr.-Amer. Rhynch. **2**: 43. pl. 3, figs. 18, 18a. 1898.
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Teleonemia dispersa Drake, Ann. Mag. Nat. Hist. (10) **8**: 227. figs. 1, 1a. 1931.
Teleonemia albomarginata Monte, Arq. Inst. Biol. **11**: 298. 1940; Rev. Bras. Biol. **3**: 107. 1943.
Teleonemia lanceolata Drake and Hambleton, Arq. Inst. Biol. **9**: 52. 1938; Drake and Poor, An. Mus. Cien. Nat. **40**: 299. 1942.

As the original descriptions of *Monanthia lanceolata* Walker (1873) and *Teleonemia albomarginata* Champion (1897) agree and the two names apply equally well to the same species, Drake and Hambleton (1938) and Drake and Poor (1942) correctly placed the latter name in synonymy. According to W. E. China, the Walker type of *lanceolata* seems to have been lost and can not be located in the British Museum. The writers have carefully studied very long series of *lanceolata* (Walker) from Brazil, Paraguay, Argentina, Perú, Venezuela, Colombia, several Central American countries, and the West Indies. Specimens vary somewhat in size, color, lateral expansions of paranota and elytra, and the height of median carina. The original description and figure of *albomarginata* by Champion are excellent.

The statements of Monte (1941, 1943) are entirely inept and based upon his opinion rather than a careful study of specimens and original descriptions. His conclusions are entirely erroneous, and the name *albomarginata* Champion will have to be suppressed as a synonym of *lanceolata* (Walker).

Teleonemia quechua Monte

Nine specimens, Satipo, April 12, 1941; 1 specimen, Challanga; 1 specimen, Vilcanoto; 2 examples, Coroico; and 12 specimens, Cañete, Perú, Edson J. Hambleton. One specimen, Villa Vicenzio, Colombia, 1898, O. Burger. In this species there is some variation in color and length of antennae. The antennae are long, moderately stout, and rather densely clothed with very short recumbent hairs; proportions

I:10, II:8, III:115, IV:40. The male tends to be a little smaller than the female. The carinae are sharply raised, thick, foliaceous, the lateral pair being slightly concave within in front.

Teleonemia absimilis, n. sp.

Elongate, broad, fuscous-brown, the paranota, costal and most of subcostal areas, collar, and raised anterior portion of median carina whitish testaceous. Appendages ferrugineous. Hind spines of head adpressed, not reaching anterior margins of eyes, the median and frontal spines short. Rostrum extending to middle of metasternum; rostral channel widening posteriorly, open behind at the middle the laminae testaceous, concave within on metasternum. Body beneath dark ferrugineous, the hind margins of abdominal segments darkened.

Pronotum moderately convex, coarsely pitted, with foliaceous carinae, each uniseriate, the lateral more widely separated and concave within in front, the median elevated in front so as to form a small rooflike hood, subtruncate in front; paranota rather narrow, uniseriate, strongly reflexed slightly wider in front. Elytra slightly widening posteriorly, very slightly constricted beyond middle, together rounded behind when in repose; costal area moderately wide, slightly reflexed along basal portion, the areolae moderately large, hyaline; subcostal area narrow, uniseriate, somewhat testaceous; discoidal area large, narrowed at base and apex, widest a little in front of middle, there six areolae deep, the inner boundary more raised; sutural area large, the veinlets (also of discoidal) only slightly raised, the areolae and veinlets embrowned.

Length, 5.60 mm; width, 1.80 mm.

Type (female), Villa Vicenzio, Colombia, January 1, 1898, Prof. O. Burger, collector.

This species is smooth, somewhat reddish brown, with very pale testaceous margins.The whitish testaceous color of costal area extends to the apex of elytra and is not interrupted behind as in *lanceolata* (Walker).

Teleonemia altilis, n. sp.

Very similar in general appearance and color to *T. molina* Drake but easily distinguished by its smaller size, shorter rostrum, wider costal area and thinner carinae. Rostrum extending a little beyond middle of mesosternum; rostral laminae brownish, thinner and not as widely separated as in *molina*. Head with five rather short, yellowish-brown spines, the three frontal shorter. Carinae uniseriate, the lateral pair slightly concave within in front. Costal area whitish testaceous, uniseriate, the areolae clear, widest opposite apex of discoidal area, there on one side with two extra areolae; subcostal area narrow, uniseriate. Paranota, hood and median carina testaceous. Appendages black-ferrugineous.

Length, 4.70 mm; width, 2.40 mm.

Type (female), Las Juntas, Bolivia. Collected by Steinbach. Separated from *T. prolixa* Stål and varieties by the wider costal area.

Teleonemia inops, n. sp.

Brownish, with some areas infuscate. Head with five spines, the hind pair longer, adpressed, the median and fore pair shorter, directed forward. Antennae ferrugineous-brown, moderately long, shortly pilose; segment III approximately two and one-half times the length of IV; I and II short, the latter smaller. Rostrum reaching near the base of mesosternum; laminae very low, widely separated on metasternum, open behind. Legs fuscous-brown, rather slender. Body beneath dark ferrugineous.

Pronotum dark brown, sharply tricarinate, each carinae uniseriate and with veinlets dividing cells fuscous, the lateral carinae more widely separated, slightly convex within in front; median carina moderately raised in front so as to form a small, rooflike hood, slightly projecting in front; paranota narrow, reflexed, uniseriate, the areolae small. Elytra considerably infuscated, mostly dark brown, the costal area (also paranota, carinae, and collar lighter in color) mostly testaceous; costal area narrow, uniseriate, slightly reflexed along basal portion, the areolae small and clear; subcostal area narrow, uniseriate; discoidal area large, widest near middle, there five areolae deep; sutural and discoidal areas rather widely areolated, the areolae opaque, brown to fuscous, the veinlets not prominent.

Length, 4.55 mm; width, 1.35 mm.

Type (male), La Ceiba, Honduras.

Separated from *T. notata* Champion by the longer antennae, less convex pronotum and wider costal area. It is a little larger than *T. scrupulosa* Stål and the discoidal area is glabrous.

Teleonemia sandersi, n. sp.

Moderately large, mostly dark fuscous, the paranota and costal areas testaceous, some of the transverse veinlets infuscate, the head and pronotum often covered with whitish exudation. Head black, with five stout, moderately long, testaceous spines, the hind pair adpressed, the median directed forward, the front pair curved inward. Rostrum extending to meso- and metasternal suture; laminae thick, testaceous, concave within on meso- and metasternum, more widely separated on metasternum, open behind. Body beneath blackish ferrugineous. Appendages dark ferrugineous, the last antennal segment black. Antennae moderately long, rather densely clothed with short, decumbent hairs; segment I thicker and a little longer than II; III slightly bent, slightly more than twice as long as IV.

Pronotum moderately convex, pitted, sharply tricarinate, each carinae uniseriate, the lateral carinae distinctly diverging anteriorly. Median carina in front and collar raised so as to form a rooflike hood, the anterior margin slightly produced. Paranota narrow, strongly reflexed, testaceous, uniseriate, the areolae moderately large; subcostal area narrow, uniseriate; discoidal area impressed, widest near middle, there five aerolae deep, the areolae rather large; sutural area rather widely reticulated, the areolae becoming larger posteriorly.

Length, 4.78 mm; width, 1.25 mm.

Type (male), Canal Zone, Panama, February 10, 1935, C. H. Richardson; allotype (female), Olhajuela, Canal Zone, February 11, 1921, J. G. Sanders; paratype, Canal Zone, Panama, taken with type.

Named in honor of Prof. J. G. Sanders, who kindly presented us the first example of the species. The sharply raised carinae, raised boundary of discoidal area and raised veinlets of elytra give this insect a striking appearance. The rostral laminae are higher and not so widely separated on metasternum as in *T. altilis;* the pronotum is also more convex and the veinlets of areas of elytra more raised and prominent.

Teleonemia vulsa, n. sp.

Resembling *T. leitei* Drake and Hambleton but with longer antennae, wider costal area, narrower subcostal area and differently colored appendages. Head brown, with five blunt, testaceous spines, the hind pair longer and adpressed. Eyes black. Antennae moderately long, brownish ferrugineous, indistinctly pilose; segment I stouter and longer than II; III long, slightly bent, a little more than three times as long as IV; IV longer than the first two conjoined, blackish.

Pronotum moderately convex, distinctly pitted, brown; paranota narrow, distinct, slightly wider in front, the areolae indistinct; carinae sharply elevated, the areolae distinct; lateral carinae distinctly more widely separated in front, there concave within; median carina and collar raised in front so as to form a rather long, small, rooflike hood, slightly produced in front. Elytra widest near middle, slightly constricted beyond middle, brown, paler along margins; costal area rather narrow, uniseriate, the areolae hyaline and moderately large; subcostal area scarcely wider, biseriate; discoidal area large, narrowed at base and apex, widest a little before middle, there five areolae deep, the areolae rather large; sutural area more widely reticulated, considerably infuscated. Legs dark brown. Rostrum not quite extending to base of mesosternum; laminae testaceous, parallel, more widely separated on metasternum, entirely open behind.

Length, 4.90 mm; width, 1.25 mm.

Type (male), allotype (female), and two paratypes, Chapada, Brazil.

Teleonemia scrupulosa Stål

This species is widely distributed in Mexico, Central America, West Indies, and South America. It has not been recorded from Chile. A number of years ago the species was introduced into the Hawaiian Islands, Fiji, and Australia for the purpose of controlling the weed *Lantana.* The insect has flourished in these countries.

Drake and Frick (Proc. Haw. Ent. Soc. **10**: 201. 1939) treat *T. haytiensis* Drake as a variety of *scrupulosa.* This conclusion was based on a study of the type of *haytiensis*, cotype and an extremely long series of specimens of *scrupulosa* from South and Central America, West Indies, Mexico, United States, and islands of the Pacific. The antennal characters seem to warrant the varietal name *haytiensis.* Certain specimens from Texas, which have been ten-

tatively identified as *scrupulosa*, need further study and may perhaps represent another variety or even a distinct species. Monte (Papeis Avulsos Dept. Zool. São Paulo 2: 103. 1942) erroneously treated *haytiensis* as a synonym of *scrupulosa*. His conclusions are not based on an examination of the type or material from the type locality; *scrupulosa* has been much confused in the literature.

Pachycysta diaphana Champion

One example, Surukun, Venezuela, November, 1940, collected by P. Anduzee. Two other examples are at hand from the Amazon region of Brazil. The type locality is "Amazona."

Amblystira pallipes (Stål)

A series of examples, Surukun, Venezuela, November, 1940, taken by P. Anduzee. Many specimens have been studied from Brazil and Colombia. Taken in numbers on Sapindaceae, São Paulo, Brazil, 1934, by Edson J. Hambleton.

Corycera comptula Drake

Five specimens, Campinas, São Paulo, Brazil, April 18, 1937, Edson J. Hambleton. The type locality is Chapada, Matto Grosso.

Corycera juncta, n. sp.

Very much like *C. separata* Drake and Hambleton but separated from it by the longer first antennal segment, testaceous paranota, rostral laminae not so widely separated on metasternum, lateral carinae of pronotum slightly less raised on disc and all carinae are thicker and more elevated on hind triangular process. Head with hind pair of spines brownish, stout, blunt, adpressed, extending as far forward as front margins of eyes; median spine wanting; front pair short, brownish, turned inward. Rostrum extending on base of mesosternum. Costal area moderately broad, whitish testaceous, biseriate in widest part, the areolae clear and moderately large. Legs pale testaceous, the tarsi a little darker. Antennae long, slender, indistincty hairy; segment I very stout, moderately long, black-fuscous; II short, slender, testaceous; III very long, testaceous; IV slightly thickened, mostly blackish, pale at base.

Length, 2.60 mm; width, 1.05 mm.

Type (female), São Paulo, Brazil, May 22, 1935, E. J. Hambleton.

Amblystira scita, n. sp.

Similar in appearance to *A. socia* Drake but easily separated from it by the slightly more raised lateral carinae and the somewhat rounded and not sharply raised apex of discoidal area. Pronotum black, somewhat shiny, pitted, the lateral carinae slightly divaricating anteriorly. Elytra blackish, the widest or biseriate portion of costal area testaceous, the areolae of sutural area somewhat whitish. Antennae testaceous, most of terminal segment black. Other characters very similar to *A. socia.*

Type (female), and paratype, Mercedes, Costa Rica, August 5, 1928.

In *A. socia*, the apical angle of the discoidal area is sharply raised, acutely angulate, and the hind margin straight; the subcostal area is also wider. Otherwise, except for the lateral carinae, the two species are very similar in appearance.

Atheas placentis Drake and Poor

Five specimens, São Paulo, February 2, 1935, collected by E. J. Hambleton. Reported by Monte as occurring on *Celtis brasiliensis* Gardn.

Atheas laetantis, n. sp.

Head black, without spines. Bucculae testaceous, closed in front. Rostrum brownish, black at apex, extending on mesosternum. Body beneath black. Antennae moderately long, slender; segment I black, slightly stouter and nearly three times as long as II; II short, blackish; III testaceous, slenderest, slightly more than three times as long as IV, indistinctly hairy; IV rather long, almost wholly black, slightly thickened, with longer, pale hairs. Antenniferous tubercles rather long, conelike, nearly straight, becoming testaceous apically. Eyes black. Legs slender, testaceous, the tarsi darkened.

Pronotum moderately convex, pitted, brownish black, sharply tricarinate, each carinae with a row of tiny areolae, the lateral pair parallel; collar distinct, dark brown, testaceous in front. Paranota rather narrow, wider in front, uniseriate opposite humeral angles, biseriate in front, the outer margin nearly straight, the areolae hyaline and moderately large. Elytra with all discoidal and subcostal areas and basal portion of sutural areas fuscous-black, the rest pale testaceous, the areolae hyaline; costal area

rather broad, mostly biseriate, triseriate in widest part, the areolae large, arranged in somewhat irregular rows; subcostal area narrow, mostly biseriate; discoidal area reaching a little beyond middle of elytra, narrowed at base and apex; sutural area mostly widely reticulated.

Length, 2.55 mm; width, 1.10 mm.

Type (male), allotype (female), and 32 paratypes, Viçosa, Minas Geraes, Brazil, April 29, 1934, on *Machaerium angustifolium* Vog. and *Machaerium* sp., by Edson J. Hambleton.

This species may be separated from *A. flavipes* Champion by the more rounded outer margins of elytra, the wider costal area, and the shorter first and testaceous third antennal segments.

Tigava lonchocarpa, n. sp.

Allied to *T. cassiae* Drake and Hambleton but distinguished by the thinner and less elevated carinae and the narrower paranota and elytra. Head brownish, the spines testaceous; hind pair of spines long, adpressed, extending beyond front margin of eyes; median spine stout, blunt, directed forward, the anterior pair atrophied. Antennae long, indistinctly pilose; segment I long, stout, constricted before apex, slightly more than three times the length of II, blackish fuscous; II short, concolorous with I; III testaceous, two and a half times as long as IV; IV slightly thickened, clothed with pale hairs, black, the basal portion testaceous. Rostrum extending to middle of mesosternum, brownish, dark at apex; laminae testaceous, constricted on mesosternum, very broad and cordate on metasternum, closed behind. Legs slender, yellowish brown. Body beneath black.

Pronotum grayish brown, moderately convex, finely pitted, tricarinate, all carinae indistinctly areolate; paranota rather narrow, uniseriate behind, biseriate in front, testaceous, the areolae rather small and clear; calli impressed, black; collar raised, narrow, testaceous, areolate; triangular process areolate, lighter in color. Elytra brownish, becoming fuscous within, the marginal area testaceous with clear areolae; costal area moderately wide, biseriate, the outer row a little smaller, subcostal area narrower, biseriate; discoidal area narrowed at base and apex, widest near middle, there four or five areolae deep; sutural area becoming more widely reticulated posteriorly.

Length, 3.85 mm; width, 1.05 mm.

Type (female) and allotype (male) and three paratypes, Viçosa, Minas Geraes, Brazil, May 6, 1934, taken on *Lonchocarpus* sp. by E. J. Hambleton.

T. sesoris Drake and Hambleton is a smaller species with shorter basal segment of antennae.

Campylotingis snipesi, n. sp.

Elongate, slender, brownish, the costal area testaceous, with some of the transverse veinlets fuscous. Head brown, with five moderately long spines, the median arising from a slightly raised area, porrect and dark fuscous, the hind pair adpressed. Rostrum extending between fore legs, the channel strongly constricted on mesosternum, rather wide and closed behind. Body beneath black. Legs long, slender, testaceous. Antennae long, slender; segment I long, stout, constricted before apex, about four times as long as II; II stout, slenderer, testaceous; III very long, slenderest, testaceous, four times the length of IV; IV black, moderately long, scarcely thickened, clothed with whitish hairs.

Pronotum moderately convex, closely pitted, tricarinate, the lateral carinae subparallel, distinct but not prominent, the median a little more raised; calli impressed, brownish, collar raised, areolate; paranota indistinct opposite humeral angles, in front expanded so as to form a distinct carinalike ridge. Elytra narrow, widely constricted beyond middle, the sutural area infuscate, costal area narrow, yellowish brown, the areolae elongate; subcostal wider, mostly biseriate, triseriate in widest part; discoidal area rather narrow, narrowed at base and apex, widest beyond middle, there three or four areolae deep; sutural area becoming more widely reticulated distally.

Length, 3.50 mm; width, 0.07 mm.

Type (male), Viçosa, Minas Geraes, Brazil, collected by Dr. B. T. Snipes. The very narrow paranota opposite calli (there wider and ridgelike) and collar separate this species from its congeners.

Leptodictya paulana, n. sp.

Akin to *L. austrina* Drake and Hambleton in general appearance and color, but separated from it by the smaller areolae of elytra, narrower form and broader paranota. Head tumid, with extremely long, slender testaceous spines.

Antennae yellowish brown to dark fuscous, long, very slender, segment III two and one-half times as long as IV. Paranota completely overlapping, biseriate above, the upper fold broadly rounded in front and not sharply narrowed posteriorly as in *austrina*. Collar at middle jointly raised in front so as to form a tectiform hood, which is slightly more produced in front than in *austrina*. Rostrum extending on metasternum. Elytra with costal area less iridescent, narrower and more closely reticulated than *austrina*. Male narrower than female. Other characters very similar to *austrina*.

Length, 3.00 mm; width, 1.35 mm.

Type (male), allotype (female), Taquaretinga, São Paulo, Brazil, March, 1939, E. J. Hambleton. Paratypes, two specimens taken with type and one specimen, Campinas, São Paulo, June, 1937, Edson J. Hambleton.

Leptobyrsa steini Stål

This species has been very much confounded in the literature by Monte (Papeis Avulsos Dept. Zool. São Paulo 1: 203–208. 1941). The writers' determinations of *steini* have always been based on one of Stål's cotypes kindly sent to us by the Stockholm Museum more than a decade ago. This confusion has been constant since Monte first attempted to identify species in the genus. The same statement applies equally to *L. baccharidis* Drake and Hambleton. Specimens of *Leptobyrsa* before us determined at various times by Monte as his *L. nigricornis* are typical examples of *L. steini*.

Perhaps some of Monte's confusion may be due to the errors in his illustrations of *steini* and *baccharidis* published in the above mentioned volume. His remarks and criticisms seem to be based to some extent on the illustrations rather than a careful study of his specimens. To illustrate, the hood of *steini* in his illustration is distinctly larger than in Stål's cotype and numerous other specimens of this species at hand from Brazil. The hood in *steini* is much smaller and does not cover the entire head (except eyes) or extend beyond its apex. The length and number of spines on the margins of the paranota and elytra in his illustrations agree with our material.

It is impossible to know what Monte has determined as *L. baccharidis*. In the type, type series, and other specimens we do not have a single specimen of *baccharidis* that agrees with Monte's figure. The hood is not so large, the frontal spines are not so long or nearly so long as the first antennal segment, and the lateral carinae are not composed of two very elongate cells. In our series of specimens of *steini*, *baccharidis*, and other members of *Leptobyrsa* Stål, the individuals of a long series of a species exhibit about the same amount of variation as in a number of other species of lace bugs. It is dif-

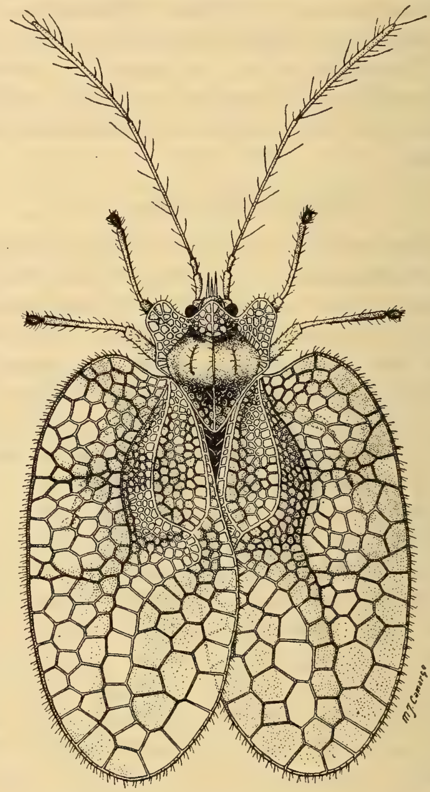

Fig. 1.—*Pleseobyrsa atratarsis*, n. sp.

ficult to understand Monte's statement "Porquano tendo coligido para mais de 300 exemplares do que Drake diz ser *steini*, todos eles, sem exceção de um so, apresentam o mesmo recúo que se ve no desenho." It will be necessary to examine specimens of what Monte has called *L. baccharidis*, *L. steini*, and *L. nigritarsis* before these errors can be rectified.

According to the cotype of *steini* Stål and type of *baccharidis* Drake and Hambleton, the hood of the former is distinctly smaller, and does not entirely cover the head in either form. The margins of the paranota and elytra are clothed with long hairs in *baccharidis* and with

shorter spines in *steini*. The tumid elevations of elytra are also a little higher in *baccharidis*.

Pleseobyrsa atratarsis, n. sp. Fig. 1

Very similar to *P. plicata* (Champion) but differs from it in having black-fuscous tarsi, smaller hood. The lateral carinae are distinct, but present only on the disk. Head with five long, slender, pale, testaceous spines, the hind pair adpressed, extending as far forward as base of front pair of spines. Subcostal and discoidal areas subequal in width, each with five rows of areolae in widest part, the discoidal area considerably elevated. Paranota mostly finely serrate, with a few spines on the anterior margins. Head moderately convex above, brownish; front pair of spines straight, not quite reaching apex of first antennal segment median a little shorter, all three frontal spines directed forward and slightly upward. Other color and other characters very similar to *plicata*.

Length, 3.60 mm; width, 2.70 mm.

Type (female), Poças de Caldas, Minas Geraes, Brazil, Col. O. W. Guilherme, July 1, 1939.

Gargaphia munda Stål

The determinations of *munda* Stål of the writers are based upon a cotype kindly sent us a number of years ago by the Stockholm Museum. Many other specimens are also at hand from the states of Minas Geraes, São Paulo, and Rio de Janeiro, collected by Edson J. Hambleton. Several years ago, Monte kindly sent the senior author specimens under the names of *G. munda* Stål and *G. trichoptera* Stål of what he later described as *brunfelsiae*. This probably accounts for Monte's erroneous statement relative to *munda* in Arq. Inst. Biol. **2**: 295. 1940. Later Monte changed his determination and then distributed what he had wrongly identified as *munda* and *trichoptera* under the label *brunfelsiae*. The latter is a valid name for a good species.

Gargaphia lanei Monte

Gargaphia lanei Monte, Arq. Zool. Estado São Paulo **1**: 376. 1940.
Gargaphia limata Drake and Poor, Rev. Ent. **2**: 228. 1940.
Gargaphia limitata Monte, Arq. Zool. Estado São Paulo **2**: 18. 1940.

According to the dates indicated in the original description, *lanei* Monte appeared on June 27, 1940, and *limata* Drake and Poor on June 28, 1940. If these journals were mailed as indicated, *lanei* Monte has date priority of one day and is the valid name of the species. A study of type material shows that the two names apply to the same species and the name *limata* Drake and Poor must be suppressed.

Gargaphia implicata Drake and Hambleton

Gargaphia concursa implicata Drake and Hambleton, Rev. Ent. **1**: 535. 1940.

After studying a large number of specimens, the authors believe that the narrower, bi- or triseriate, subangulate paranota opposite humeri and the almost uniformly rounded (not distinctly arched) median carina represent specific differences. The hood is also larger and much more inflated than in *concursa* Drake. The subcostal area is either bi- or triseriate. The type is a female and allotype, male. There are 21 paratypes. Other specimens are also before us from Brazil, Paraguay, and Argentina.

Gargaphia nigrinervis impedita, n. var.

Separated from typical *G. nigrinervis* Stål by the distinctly narrower, subrounded angles of paranota opposite humeri. Paranota triseriate in widest part, the areolae large, hyaline. Median carina foliaceous, uniseriate, not distinctly arched, slightly more elevated behind. Color and other characters very much like *nigrinervis*.

Length, 4.20 mm; width, 2.25 mm.

Type (male), Río Frío, Colombia, April 2, 1926.

In *G. nigrinervis* Stål the paranota opposite humeral angles are wider and produced into acute points, there four or five areolae deep. In *G. deceptiva* (Drake) the paranota angles are very similar to *G. nigrinervis* Stål but the median carina is very strongly elevated, strongly arched behind hood, and very much higher than in *impedita* or *nigrinervis*.

Dyspharsa, n. gen.

Head very short, with five spines. Antennae very slender, long, indistinctly pilose; segment I short and a little stouter and longer than II; III very long, slenderest; IV slightly thicker than III. Rostral channel widening posteriorly, the rostrum moderately long. Bucculae closed in front, areolate. Orifice present. Eyes placed close to pronotum. Pronotum strongly convex,

pitted, unicarinate. Hood rooflike, covering base of head. Paranota narrow, linear. Legs slender. Elytra distinctly lacy, expanded near the base, divided into usual areas; discoidal area short, not reaching middle of elytra.

Type of genus, *Leptopharsa myersi* Drake.

This genus resembles in general appearance very closely *Acysta* Champion but it has a distinct hood. The pronotum is sharply convex and highest at center of disk, unicarinate. The discoidal area is short. These characters will also separate it from *Leptopharsa* Stål. In the latter, the pronotum is more or less transversely convex.

Leptopharsa perbona Drake

Leptopharsa perbona Drake, Amer. Mus. Nov., No. 398: 2. 1930.
Leptopharsa spectabilis Monte, Arq. Inst. Biol. **11**: 290, fig. 7. 1940.

As it is impossible to separate *perbona* Drake and *spectabilis* Monte, the latter name should be placed in synonymy. The species is not very closely related to *G. munda* Stål, either in appearance or structure.

Leptopharsa distinconis Drake

Leptopharsa distinconis Drake, Iowa State Coll. Journ. Sci. **3**: 54. 1928.
Leptopharsa iridis Drake, Amer. Mus. Nov., No. 398: 2. 1930.

Numerous specimens of this insect were collected at Pirassununga, São Paulo, March 30, 1936, and Belém, Pará, October 9, 1938. The variations in these series and other examples make it impossible to distinguish *distinconis* and *iridis* and the latter name is here placed in synonymy.

Leptopharsa satipona, n. sp.

Small, whitish testaceous, the head black, the pronotum darkened. Head with five long, slender, testaceous spines, the hind pair curved downward. Antennae very long, slender, smooth; segment I very long, black, slightly more than three times as long as II; segment II short, black-fuscous; III testaceous, very long, slightly more than twice as long as IV; IV very long, slightly thickened, blackish, with short, pale hairs. Legs testaceous, slender. Rostrum extending slightly beyond mesosternum. Body beneath black.

Pronotum moderately, transversely convex, pitted, tricarinate; collar raised, the marginal row of areolae whitish testaceous; paranota rather narrow, reflexed, oblique, projecting upward, whitish testaceous, biseriate, the outer margin nearly straight, the areolae hyaline; lateral carinae very low; median carina more elevated, not areolate; posterior triangular projection reticulate, pale testaceous. Elytra constricted beyond middle, some of the veinlets fuscous; costal area moderately wide, mostly biseriate, triseriate in widest part, the areolae rather small; subcostal area very narrow, biseriate, the areolae tiny; discoidal area short, narrower in front than behind, widest a little beyond middle, there five areolae deep; sutural area with distal areolae larger and some of the veinlets brownish.

Length, 2.70 mm; width, 1.00 mm.

Type (male), Satipo, Perú, August 9, 1941, P. Paprzycki.

This is one of the very smallest members of the genus. The broad costal area and very long antennae separate it from the other smaller species of the genus.

Stephanitis parana, n. sp.

Moderately large, strongly widening posteriorly, the nervures brownish testaceous, the areolae hyaline and somewhat iridescent. Head, save eyes, concealed by the hood, brownish. Antennae very long, slender, shortly pilose, testaceous, the last segment dark fuscous; segment I moderately stout, long, broadly constricted before apex; II short, one-fourth the length of I; III long, slenderest; IV extremely long, scarcely thicker and three-fourths the length of III. Rostrum long, yellowish, black at tip, practically as long as channel. Legs very long, slender, testaceous. Orifice distinct.

Pronotum slightly convex, pitted, black, the triangular portion areolate and testaceous: lateral carinae present on disk, testaceous, rounded above, with three or four hyaline areolae; median carina very high, practically as high as hood, with top margin rounded, mostly biseriate, with areolae large and hyaline, the marginal nervure and some of transverse veinlets fuscous. Hood moderately large, inflated, extending a little before apex of head, slightly compressed laterally, the areolae hyaline. Paranota very wide, reflexed obliquely upward, the outer margin rounded, the areolae moderately large and hyaline. Elytra divaricating posteriorly, their apices widely separated when at rest the costal margin broadly

rounded; costal area very wide with large areolae, five deep in widest part; subcostal area biseriate adjacent to discoidal; discoidal area short, extending about one-fourth of its length beyond apex of triangular process of pronotum, obovate in shape, three areolae deep in widest part, areolae of sutural area subequal in size to those of costa.

Length, 3.60 mm; width, 2.00 mm.

Type (male), allotype (female), and two paratypes, Pará, Brazil, October 9, 1938, taken by E. J. Hambleton and H. F. G. Sauer.

This species is not easily confused with other members of the genus. The lateral margins of elytra are not clothed with hairs, the antennae indistinctly pilose, the discoidal area less raised or inflated, and the general color of nervures darker than in other Brazilian species.

Corythucha globigera Breddin

Corythucha globigera Breddin, Soc. Ent. **16**: 81. 1901.

Type (male), Santa Inez, Ecuador, R. Haensch, Breddin collection, which was kindly sent us by the late Dr. Walter Horn, of the Berlin Museum. Numerous specimens, Lima, Perú, April 25, 1936.

Hood large, strongly inflated behind, abruptly constricted near the middle and sharply narrowed anteriorly. Elytra with moderately large, tumid elevation, the costal area triseriate. Two spots on each paranotum, one or two spots on tumid elevation, a transverse band near base and another near apex of elytra, dark fuscous; apical band of elytra sometimes more or less obsolete. Hood somewhat infuscated. Median carina about one-third as high as hood, slightly arched in front, mostly uniseriate, usually with two or three areolae divided at highest part; lateral carinae distinct. Margins of paranota, elytra, and some of veinlets of hood, elytra, and median carina beset with short spines.

ENTOMOLOGY.—*Some genera of flies of the family Syrphidae.*[1] Frank M. Hull, University of Mississippi. (Communicated by Alan Stone.)

Recent studies of syrphid flies have disclosed several forms that do not appear to belong properly in any present genera. These are based upon undescribed species. In addition, I now find that the fly *Meromacrus vittata* Hull described several years ago should be assigned to a new genus for reasons given below.

Lycopale, n. gen.

Medium-sized flies of the subfamily Eristalinae with bright-yellow, flattened tomentum upon the thorax, bare eyes, and open marginal cell. Antennae short, the third joint oval, with dorsal arista. Front tomentose. Face with abundant pubescence and some pile, obscuring the ground color. Thorax black, pollinose, with thick, rather long, and dense tufts of yellow tomentum along the suture and edge of humerus. Scutellum simple. Abdomen oval, rather convex, the color metallic black, the pile rather appressed and short. Wings with helophiline venation and a prominent dip in the third vein. Anterior margin brown; marginal cell widely open. Legs simple, the hind femora a little thickened and having a patch of spinules at its base.

Genotype: *Meromacrus vittata* Hull.

This genus is related either to *Meromacrus* Rondani through its tomentose pile or to *Helophilus* Meigen through its open marginal cell and vittate thorax. The latter relationship seems more probable. The genus differs considerably in its facies from *Helophilus;* the abdomen is much more convex than in our northern broad and flattened species of that genus, and has besides the same peculiar pile which characterizes *Meromacrus.*

Kryptopyga, n. gen.

Eyes of male very widely separated, the upper half of occiput extraordinarily tumid and swollen but not rounded posteriorly. The rounded, swollen, anterior part ends in a rim that marks the edge of a deep, concave cup. Face practically vertical, a little vertical below. Antennae unusual, very elongate and slender. The first joint is long; the second joint is so short as to be almost overlooked; the third is very long, at least three times as long as the first and densely long, erect pilose on one side; the dorsal arista is practically eliminated, a

[1] Received September 15, 1943.

minute spurlike remnant being all that remains. Thorax not unusual. Scutellum broad and narrow without spur, spine, or indentation. Abdomen elongate, a little attenuated basally. The third and fourth segments are greatly dilated into a subquadrate club; the fourth segment takes the form of a vertical, downward directed, expanded hypopygium; this pseudohypopygium is hidden between the overlapping sides of the third segment; the true hypopygium can be barely seen from a ventral aspect. Legs small and weak, the hind femora spindlelike and microdontine. Venation typically microdontine.

Genotype: *Kryptopyga pendulosa* n. sp.

This genus is closely related to the odd African *Ptilobactrum* Bezzi. It is distinguished from it chiefly by the subpetiolate abdomen and the elongated pseudohypopygium.

Kryptopyga pendulosa, n. sp.

Male.—Length 12 mm excluding antennae; antennae 5.3 mm.

Head: the occiput and vertex exceedingly bloated and tumid; the eyes broadly separated, the posterior margin of occiput sharp and shelving instead of rounded. Face bulbous on the lower portion, in ground color light brown becoming brownish yellow ventrally and along the sides, leaving the middle broadly darker brown. Pile of face pale, shining brassy and appressed. The vertex and upper part of front are dark shining brown with short pale pile; the area immediately above the antennae and on its sides is shining chestnut-brown and bare. Antennae extremely long and pendulous. The first joint is slightly curved, flattened upon the inner surface, barely over one-fourth as long as the third joint; the second joint is minute and buttonlike and about one-eighteenth as long as the third joint; third joint slender, enlarged just before the blunt apex, 4 mm long, and upon the outer half thickly clothed with long, erect, delicate, dark-brown pile. The arista is a mere spur, located a short distance from the base of third joint. Eyes bare.

Thorax: dark, dull brownish black, with faint trace of the darker brown, pair of slender, widely separated, medial vittae that are confluent a short distance before the scutellum. Outside of this pair of vittae on each side there is a wide, longitudinal stripe of appressed, golden pile, reaching almost to the scutellum and crossing a slender transverse band of similar pile running along the transverse suture, which, however, extends only a short distance inward medial to the longitudinal stripe. Posterior margin of humeri banded with similar pile. Scutellar margin almost evenly rounded but actually very bluntly protuberant in the middle; its color yellowish brown.

Abdomen: elongate, club-shaped, scarcely narrowed basally, the third segment slightly wider than the basal half of the abdomen. First segment elongate, pale brown, subtranslucent, strongly transverse striate, darker brown upon its anterior corners and concolorous posteriorly with the basal half of the rather long second segment. Second segment darker brown posteriorly. Third segment barely longer than the first two segments, dark brownish black, produced downward into an enormous, thickened club, the fourth segment actually vertical and thrust downward, simulating a false hypopygium. The false hypopygium is actually concealed by the third segment which is so curved around that only a small opening is visible ventrally by turning the fly upside down. The third segment of the venter is produced into a curious shield-shaped overlapping flap, which serves still further to close off the genitalia.

Legs: dark reddish brown, blackish upon the basal half of the hind femora, extensively upon the middle femora. Anterior femora more reddish brown. Anterior tibiae basally and almost the whole posterior tibiae reddish brown; elsewhere these and the middle tibiae are blackish; there is silvery pollen upon the tibiae in several places. Hind femora moderately thickened, spindly upon the basal half.

Wings: strongly tinged with brown, with heavy stigmal cross vein, well developed vena spuria and a strong brown patch, diffuse-edged, occupying part of the apex of the wing.

Holotype.—One male. Soekaboemi, Java, May 1926, purchased from E. Le Moult, 1933-189. In the British Museum of Natural History.

Remarks.—This fly is related to the African *Ptilobactrum* Bezzi, in which, however, the antennae are not so long nor is the abdomen elongate nor does it terminate in such a peculiar fourth segment. In the females of *Ptilobactrum* the antennae are without the plushlike pile. *Kryptopyga* differs from *Paramixogaster* Brunetti in the presence of the long pile upon the

antennae of the male. The antennae of that genus are bare in the male and lack the curious development of the abdomen, although the abdomen is pedunculate. There are several Australian species with elongate but nonhairy antennae and with normal abdomen.

Genus **Spheginobaccha** de Meijere

Dexiosyrphus, n. subgen.

Elongate flies of medium size or larger. The head is subglobular, the occiput tumid, swollen, and rounded. Eyes narrowly separated, approximated about halfway between ocelli and antennae in the male. Antennae short, the third joint oval with dorsal arista. Face retreating with a barely suggested tubercle. Occiput deeply incised at a point on either side near the top. Thorax almost bare, the pile microsetate. Transverse suture produced as a complete deep crease across the whole of the mesonotum. Abdomen elongate, subcylindrical, and slightly attenuated. The legs have the hind femora slender, their base tapered and spindle-formed, their apex without trace of spines. Wings heavily villose. Marginal cell widely open; apical cross vein spurred below. There is no upward spur from the last section of the fourth longitudinal vein below the end of vena spuria.

Type of subgenus: *Spheginobaccha* (*Dexiosyrphus*) *funeralis*, n. sp.

This subgenus is related to *Spheginobaccha* de Meijere. It differs in the presence of the deep crease across the mesonotum and the virtual absence of the upward spur from the fourth vein.

Spheginobaccha (Dexiosyrphus) funeralis, n. sp.

Male.—Length 14 mm; wing 10 mm.

Head: subglobular, the occiput tumid and strongly developed posteriorly adding to the globular shape of the head. There is a strong, submarginal crease in the occiput a short distance down on each side of the eye margins which from above appears as a V-shaped fissure on the back of the occiput. Occiput and vertex and face and front black in color, the occiput grayish white pollinose. Ocelli set well forward close to the point of approximation of the eyes; the eyes fail to meet by a distance equal to the width of the posterior ocelli. There is a low facial tubercle near the middle of the face and the cheeks are almost absent. Antennae short, the third joint large, oval, about one-half again as long as wide, the arista short, slender except at the extreme base; first antennal joint dark brown, second and third light brownish orange. Pile of face, front, and vertex black, of the posterior occiput above and below whitish in color.

Thorax: dark black, dully shining with on each side a rugose stripe which at the level of the posterior humeri broadly diverges and is hence continued as two stripes almost to the end of the thorax. Pile of thorax very short, almost microscopic. Scutellum and pleura black, the former with a few rugae, the posterior margin of the mesopleura and the whole ventral part of the pteropleura with thick silvery pollen.

Abdomen: very long, somewhat slender, narrower than the thorax, slightly club-shaped on the third and fourth segments, subcylindrical in shape; the first, whole of the second, and base of the third segment with numerous very fine transverse linear grooves or furrows. On the sides of the second segment just before the middle, submarginal in position, is a pair of small, oval, diagonal, silvery pollinose spots, pointed at each end. Abdomen black and chiefly shining; the sides of the long second and third segment, which are together practically as long as the remainder of the abdomen, are quite parallel; sides of second segment emarginate; on the sides of the third and fourth segment, widely separated in the middle is a pair of slender diagonal pilose and pollinose-margined hair-bands.

Legs: almost wholly light reddish brown, the base of the hind femora, the basal third or half of all of the tibiae pale yellow, the hind femora slightly thickened, the pile everywhere very fine and exceedingly sharp-bristly and flat-appressed.

Wings: pale brown. There is no spur from the third longitudinal vein, no stigmal cross vein, the vena spuria is well developed, the wings are uniformly villose, the terminal sections of the subapical and postical cross veins are almost straight and slightly wavy in the latter.

Holotype.—One male. South Africa, R. E. Turner 1933-69; East Cape Province, Katberg, 4,000 feet, XII, 1932. In the British Museum.

Spheginobaccha dexioides, n. sp.

Distinguished from *S. macropoda* Bigot by the replacement of the yellowish, translucent, subtriangular spots of the abdomen with slen-

der, diagonal, gray-pollinose bands, most conspicuous upon the fourth segment.

Male.—Length 14 mm; wing 10 mm.

Head: occiput tumid, silvery gray pollinose, the crease very conspicuous. Vertex shining brown, somewhat convex, becoming light chestnut-brown on a wedge behind the ocelli. Eyes approximate, failing to touch by a distance equal that between the posterior ocelli. The front is shining brown. Face dark brown, shining. There is a narrow, transverse band of yellow pubescence across the face at the epistoma and up narrowly along the eye margins. Antennae short, wholly reddish brown, the third joint about twice as long as wide, dully pointed. Eyes bare.

Thorax: black, feebly shining; microscopically pilose, mixed black hairs among brownish yellow hairs. There is a rugose area on each light-brown humerus, and on each medial edge of the humerus there is a similar area that immediately divides to form slender stripes running the greater part of the thorax. Scutellum broad, very convex, dark brown. The pleura are black with a narrow, vertical, silvery stripe. There is a tuft of long, golden-yellow hair on the anterior margin of the propleura. Squamae rather short, pale in color.

Abdomen: rather elongate, basally petiolate, the first and second segments and the basal third of the third segment with almost parallel sides. Actually the first segment is a little wider than the second and the club-shaped fourth segment and terminal part of the third segment are three times as wide as the second segment. Abdomen subcylindrical, the fourth segment considerably longer than the third segment, the third segment barely shorter than the second segment. Abdomen shining black, chiefly dark brownish black on the fourth segment, with a diagonal, grayish-silvery pollinose stripe on the sides of the second segment before the middle, widely interrupted. There is a similar diagonal stripe in the opposite direction on the third segment and on the fourth segment a diagonal, subbasal, silvery-gray stripe practically continuous across the middle. Pile of abdomen flat, bristly, black except on the light pollinose area where it is pale yellowish. Sides of third and fourth segments strongly curved over.

Legs: chiefly dark brown, the base of all the femora, the basal third of all the tibiae yellowish. The apical half of the anterior femora beyond the strong basal bulge and bend are light reddish brown. Hind femora slightly thickened basally.

Wings: nearly hyaline, clear brownish along the anterior marginal edge to the end of the costa. Third longitudinal vein straight without spur into the first posterior cell. There is a spur from the fourth longitudinal vein into the first posterior cell near the end of the vena spuria.

Holotype.—One male. Port St. John, Pondoland, November 1923, South Africa, R. E. Turner, 1924-6. In the British Museum.

ZOOLOGY.—*Zoeal larvae of the blue crab* Callinectes sapidus *Rathbun.*[1]

MILDRED SANDOZ, Virginia Fisheries Laboratory, and SEWELL H. HOPKINS, Texas A. and M. College. (Communicated by WALDO L. SCHMITT.)

In 1942 eggs of the blue crab were hatched in the laboratory under favorable and unfavorable environmental conditions. Controlled experiments showed that under favorable conditions blue-crab eggs hatch into normal first crab zoeae. Eggs heavily infected with fungi or bacteria and those kept under unfavorable salinity and temperature conditions either failed to hatch or hatched into prezoeae that usually died soon. The optimum salinity range for hatching was found to be about 23 to 30 parts per thousand. Eggs failed to hatch outside the temperature range of 19°–29° C. Churchill (1942) concludes that there is a prezoeal stage in the blue crab. Our data clearly show that occurrence of prezoeae after hatching is not a normal one, but a result of development under unfavorable environmental conditions. Williamson (1910), working on *Portunis puber*, also of the family Portunidae, states that the larvae were obtained in the first zoeal stage.

[1] Received January 19, 1944.

In studies on development the first three zoeal stages were reared in the laboratory. The first and second zoeae were found to correspond with the descriptions and drawings of these larvae by Hopkins (1943) and in most respects with the characteristics presented by Churchill (1942). The third zoeae, however, showed marked differences from the third zoeae described by Churchill (1942). The three significant morphological differences are: (1) There are eight swimming setae on the exopodites of the first and second maxillipeds; (2) the exopodite of each antenna is still short as in the second zoea, not prominent as in Churchill's third stage; and (3) there are no strong dorsal spines on the fifth abdominal segment. Churchill states that (1) the exopodite of the first maxilliped has six setae and the second maxilliped has seven; (2) each antenna bears a prominent exopodite; and (3) there appears for the first time a pair of large strong spines on the dorsal side of the fifth segment. He figures a prominent chromatophore in the basipodite of the first maxilliped of the third stage, but his fourth and fifth stages lack a corresponding chromatophore. This phenomenon, if true, is most unexpected, since carcinologists appear to agree on the constancy of pigment characters for purposes of larval identification (Williamson, 1910, and Behre, 1941).

Churchill's description of the third stage is based on zoeae collected in plankton tows and not on larvae reared under observation. It represents a zoeal stage of another crab. Also, his fourth and fifth stages do not seem to be larvae of the blue crab.

As pointed out by Hopkins (1942), the fact that other portunid crabs are known to occur in the lower part of the Chesapeake Bay and in the ocean just outside of the bay makes it seem dangerous to draw too definite conclusions as to the identity of the zoeal stages on a basis of plankton tows alone.

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PROCEEDINGS OF THE ACADEMY AND AFFILIATED SOCIETIES

ANTHROPOLOGICAL SOCIETY

The Anthropological Society of Washington at its annual meeting held on January 18, 1944, elected the following officers: President, T. Dale Stewart; Vice President, Regina Flannery; Secretary, William N. Fenton; Treasurer, Waldo R. Wedel; Members of the Board of Managers, W. M. Cobb, Wm. H. Gilbert, H. W. Krieger, Alfred Métraux, Julian H. Steward.

A report of the membership and activities of the Society since the last annual meeting follows:

Life members, 1; active members, 53; associate members, 13; total, 67. This represents an increase of 13 over last year.

The members elected during the year were: Dr. Gordon T. Bowles, Mrs. Marion Hale Britten, Dr. Edwin G. Burrows, Miss Elizabeth Pearson Clark, John Hadley Cox, Dr. James A. Ford, Philip Edward Fowler, Mme. Nadya Georges-Picot, Dr. Katherine Luomala, Dr. A. Métraux, Dr. Maurice A. Mook, Miss Ruth E. Pardee, Robert L. Rands, Dr. Demitri B. Shimkin, Dr. Gordon R. Willey, active members; Mrs. Marjorie Lismer Bridges, Capt. Wendell P. Roop, U.S.N.R., Dr. Afif I. Tannous, Lt. Col. George Williams, associate members.

Two members, Dr. Aleš Hrdlička, life member, and Dr. Sophie Nordhoff-Jung, associate member, were lost by death. The Society voted to record its deep sense of loss at the death of these members and to extend its sincere condolences to their relatives.

The Treasurer's report is as follows:

Funds invested in Perpetual Building Association (with interest to date)	$1,762.92
21 shares Washington Sanitary Improvement Co. No. 505 (par value $10 per share)................	210.00
2 shares Washington Sanitary Housing Co., No. 222 (par value $100 per share)...................	200.00

U. S. Saving Bond, Series G., No. D96697G	500.00
Cash in bank	399.52
	$3,072.44
Bills outstanding:	
To American Anthropological Association (subscriptions to American Anthropologist for 18 members at $5 each)	90.00
To Cosmos Club	23.40
	$2,959.04
Total as of January 18, 1944	2,836.50
Increase	$122.54

Division of annual surplus:

	Previous	*1944*	*Total*
Publication fund	$102.22	40.84	143.06
Speakers' fund	102.23	40.85	143.08
Investment fund	102.24	40.85	143.09

The Society acted as host to the American Anthropological Association at the annual business meeting of the latter on December 7, 1943, at the Cosmos Club.

All regular meetings were held at the U. S. National Museum. Continuing the practice adopted in 1942, the mailing list has been kept current so as to include all anthropologists in Washington; 160 notices were sent out for regular meetings.

The Society has been the gainer by the influx of scientific workers to Washington. No difficulty has been encountered in enlisting interesting speakers, and offerings have reflected a policy of keeping our science abreast of world problems at home and abroad. Areas represented were Latin America (2 papers), Oceania (1), India (1), and North America (2); and problems ranged from the Japanese in America to caste in far-off India; from Shoshonean children to music in Polynesia. We have endeavored to keep anthropology alive for those whose careers are momentarily diverted. Two of the papers presented have been published.

The papers presented before the regular meetings of the Society were as follows:

January 19, 1943, 711th meeting, Dr. RALPH BEALS, *Acculturation in Mexico.*

February 16, 1943, 712th meeting, Dr. DAVID G. MANDELBAUM, *Some aspects of social organization in India.*

March 16, 1943, 713th meeting, Dr. JOHN F. EMBREE, *The Japanese in America.* (Published in this JOURNAL **33** (8): 238–242. Aug. 1943, under the title *The relocation of persons of Japanese ancestry in the United States: Some causes and effects.*)

April 20, 1943, 714th meeting, Dr. DEMITRI B. SHIMKIN, *Personalities and social interactions among Wind River Shoshone children.*

October 19, 1943, 715th meeting, Dr. WILLIAM DUNCAN STRONG, *Cross sections of New World prehistory—A brief report on the work of the Institute of Andean Research Program, 1941–1942.* (Published in full in Smithsonian Misc. Coll. **104** (2): 46 pp., 33 pls. 1943.)

November 16, 1943, 716th meeting, Dr. EDWIN G. BURROWS, *Music in Polynesian culture.*

The regular December meeting was omitted in favor of meeting with the American Anthropological Association at its annual business meeting.

WILLIAM N. FENTON, *Secretary.*

Obituaries

CHARLES FREDERICK MARVIN, long-time chief of the U. S. Weather Bureau, passed away on June 5, 1943, in Washington, D. C., at the age of 84, after 50 years of government service followed by almost 10 years in retirement with well-earned time for his personal pursuits. Death followed a brief illness subsequent to a minor operation. Dr. Marvin was born in Ohio, in the city now called Zanesville, on October 7, 1858, son of Charles F. and Sarah A. (Speck) Marvin. His education was acquired almost entirely in Columbus, Ohio, first in the public schools of the city and finally in the Ohio State University, where he received his degree in mechanical engineering in 1882 and later the honorary doctor of science (1932). During the four years just preceding his graduation, he served as instructor in the mechanical and physical laboratories of the university.

Dr. Marvin enjoyed an unusually well-ordered and consummate life. He entered the employ of the Federal Government soon after his graduation when he was appointed a junior professor in the Signal Service of the Army in 1884. When the meteorological work of that organization was transferred to the Weather Bureau in 1891, Dr. Marvin went with it. His early work with the Bureau as professor of meteorology was related primarily to design and maintenance of meteorological instruments, an interest that he retained throughout his active career. For several years preceding his selection to head the Weather Bureau, he was the head of its instrument division. In

1913, on recommendation of the National Academy of Sciences, he was appointed chief. With 21 years to his credit in the highest position in the Bureau, he retired in 1934 to pass several happy years with his family in private life, free from the problems of public administration and the complexities of meteorological questions.

Dr. Marvin's span of service encompassed a most interesting and important period in the evolution of meteorological science and the Weather Bureau. He entered the work in an hour of opportunity, during one of the recurring phases in meteorology when the public interest in vital weather information creates the demand that something be done about it. Apropos is a reference from the account by Prof. T. C. Mendenhall, published by Dr. W. J. Humphreys in his *Biographical memoir of Cleveland Abbe.* In referring to the importance of a theoretical investigation of the general principles of meteorology with a view to improvements in weather forecasting it is stated that: "The vitalization of the service through these important changes resulted, happily, in the acquisition of such young men as Marvin, Fassig, McAdie, Morrill, McRae, Russell and a number of others, some of whom are still in the service (1919) and from several of whom have come in later years contributions to the science of meteorology of very great value."

During his early years in meteorology, Dr. Marvin contributed greatly to improvements in design of meteorological instruments and increase in exactness of measurements. He pioneered in instruments to measure upper air conditions by means of kites, as witness the Marvin meteorograph and the Marvin treatise on kite design. These constituted an early approach to the research in aeronautical meteorology that has become a primary responsibility of the Weather Bureau since modern aviation came into its own toward the close of Dr. Marvin's career. He worked on many other instruments—the Robinson cup anemometer for wind velocity, the barometer and barograph for recording atmospheric pressure, and instruments for measuring evaporation, rainfall, snowfall, sunshine, cloudiness, air temperature, and humidity. His humidity equations and tables based thereon are still in common use to determine moisture content of the air. His work included design of a seismograph long used in the Weather Bureau.

Dr. Marvin's scientific interest and his position in the Bureau led him into many other activities and relationships. Among the scientific organizations in which he took an active part at one time or another and held leading office were the National Advisory Committee for Aeronautics, the Washington Academy of Sciences, the Philosophical Society of Washington (president 1903), and the American Meteorological Society (president 1926). He was also a member of the Cosmos Club. He represented the United States in important international scientific meetings. In 1928 he was knighted by the King of Norway in recognition of aid given by the Weather Bureau in Amundsen's Arctic explorations, and in 1934 he was a delegate to the League of Nations, Genoa. He was actively interested in calendar reform and devoted much time and study to the logical presentation of his views.

Surviving are a son, Charles F. Marvin, Jr., two daughters, Mrs. Claude Livingston and Mrs. Park Norwood, and a host of friends acquired during his many kindly and considerate associations in the more than half century of his eventful life.

F. W. Reichelderfer

After a brief illness Edward Hall Bowie passed away on July 29, 1943, at his home in Berkeley, Calif., following more than 50 years of service dedicated to his chosen science of metereology. He was born at Annapolis Junction (near Bowie), Md., on March 29, 1874, and attended St. John's College, Annapolis, Md., later receiving the degree of master of science from that institution. In December, 1891, he entered the Weather Bureau shortly after it had been transferred from the Signal Corps of the Army to the Department of Agriculture. He served at Memphis, Tenn., Montgomery, Ala., Dubuque, Iowa, Galveston, Tex. St. Louis, Mo., Washington, D. C., and San Francisco, Calif. While at St. Louis his ability in forecasting first attracted attention, and as a result he was assigned to the Washington, D. C., office, where he served as forecaster from 1909 to 1924. He was then selected to administer the important forecast district comprising the Pacific States.

His service at Washington included the period of World War I, during which he was commissioned a major in the Signal Corps, U.S.R., serving overseas with that organization in developing and inaugurating a meteorological service for the A.E.F. In this work he took an active part in furnishing advices for aviation, shipping, submarine patrols, gas and flame service, and general operations, including the making of extended forecasts.

His interest in meteorology and especially in weather forecasting induced him to accomplish a prodigious amount of reading in these fields. Few have studied the daily weather charts with greater assiduity and understanding. As a result he made many contributions to forecasting knowledge, to be found chiefly in the Monthly Weather Review and other publications of the Weather Bureau. Among these were "Methods for Predicting the Movements of Cyclones, etc.," "Types of Storms in the United States, etc.," "Types of Anticyclones of the United States, etc.," and "The Formation and Movement of West Indian Hurricanes." In addition he was a member of the board of editors of a book entitled *Weather forecasting in the United States*, a pioneer publication of its kind. His contributions to the technique of making extended forecasts from synoptic Northern Hemisphere charts attracted favorable comment.

In 1936 he visited most of the organized weather services of the Far East for the purpose of increasing the number of weather observations available for the benefit of ocean navigation. Following this survey he was designated as representative to the Southwest Pacific Meteorological Commission held at Wellington, New Zealand. A voyage on board the French Merchant Marine Training Ship, the *Jacques Cartier*, at the request of the French Government, made it possible for him to suggest improvements looking to increased availability of radio weather reports from ships at sea in the North Atlantic.

For some years, especially during the early period of its development, he took an active part in the deliberations of the Meteorological Section of the American Geophysical Union and served as president of the section of meteorology and later as a member of the Special Committee on Meteorology and Hydrology. At the time of his death he was president of the American Meteorological Society. He was also a member of the Washington Academy of Sciences, the Philosophical Society of Washington, and the Royal Meteorological Society (London).

Major Bowie put his whole heart into any project he undertook and pursued it with energy and vigor to its conclusion. Progressive and quick to make decisions, his alert mind and broad vision, bulwarked by an unusual background of meteorological experience, caused his advice and counsel to be much sought. The impress of his influence will be felt for many years to come. He was admired and respected by all with whom he came in contact. He is survived by his widow and three married daughters.

R. H. Weightman

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JOURNAL
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LINGUISTICS.—*Origin of clock-dial V and of zero.*[1] JOHN P. HARRINGTON, Bureau of American Ethnology.

In the writing of the entire world there are to be found only six types or systems of figures. Since this fact has never before been brought out, and since the two types of writing figures employed by us are derivative, it will be well first of all to list these types.

1. *Bar.*—Enregistering each unit as a mark, by the placing of something, or by some other signaling of a tally, is the indication of figures most natural to human beings and is well exemplified by the figure system of the Maya, an American Indian population, called the "simple system" to distinguish it from the combinatory system used by the same people. In the Maya system a unit is written as a dot rather than as a bar, while the bar is reserved for the writing of 5. For those figures in the writing of which both dot and bar occur, the dot or dots are placed above a horizontal bar or bars but to the left of a vertical bar or bars, it being immaterial whether the bar be placed horizontal or vertical. The bar system is so simple and self-explanatory that it appears mixed into other systems, as, for instance, into the Chinese, the Roman, and the Arabic systems, as we shall mention below at the close of this listing; it is conspicuously adapted to the writing of 1, 2, and 3 and sometimes of the superquintal derivatives of these, but becomes cumbersome with the writing of 4.

2. *Ideographic.*—This system is well exemplified by the number symbols of Chinese starting with 4, each of the symbols being in origin a picture of a numeral. The Chinese number system is decimal, and for 10 there is written a cross, reminding one of the cross or X by which 10 is expressed in some other systems. Also in ancient Egyptian are to be found ideographic figures. It is very likely that both in Chinese and Egyptian, as in ancient India, certain numerals were identified with certain nouns. For instance, in Egyptian the sickle has in some way become identified with the numeral for 9 and conventionalized as the ideograph for 9.

3. *Alphabetic.*—A language having an alphabet has the letters of this alphabet, whether phonetic or syllabic, for practical purpose in a certain order, known as alphabetic order. As one learns to say an alphabet it becomes natural to assign to each letter a number, and although these numbers would, strictly considered, be ordinal, it is practical to make them cardinal. The common method of writing figures in Greek, for example, was by writing letters. Alpha stood for 1, beta for 2, etc. Many other alphabets had, or have, the same system in practice. Ancient Hebrew used letters of its alphabet as figures, and as such they appear in the numbering of the Psalms. Hebrew had this lettering system as early as the second century B. C. and probably much earlier. This attribution is doubtless as old as the alphabet itself; compare the parallelism of the days of the week being spoken of from the very start also as first day, second day, and so forth.

4. *Alphabetic-decade.*—In the Karosthi figure system of ancient India, *a*, the first letter of the alphabet, stood for 10, not for 1. This is apparently the only evaluate of this sort known to have occurred in the alphabetic world. This strange evaluation of *a* shows that 10 is felt to be a main or round number. That 10 is felt to be the

[1] Received December 18, 1943.

A-number-one grouping is evidenced by several other decimal-system languages, being indicated, for instance, by the dd, 20, of the Attic system, the XX, 20, of the Roman system, and in fact by the choice of X for 10 in this latter system versus the standing of X in the Attic system for Greek xíilioi, 1,000.

5. *Initial.*—In the writing of numerals we find that it has been largely the practice in the earlier world to base a system of figures on abbreviated initials—just as indeed the alphabet itself consisted in origin of pictures, each picture symbolizing an initial sound, a conventionalized drawing of a house, baitu in primitive Semitic, standing for *b*, and so forth. We find this numeral-initial-equals-figure system in swing in the Attic figures of ancient Greece and the Roman figures of Latin, which are still in use as our Roman numerals. The Arabic world exhibits both Arabic alphabet figures and the India-derived figures that we call Arabic, in northern Africa the European forms of these figures being in use.

6. *Etymal.*—Persian (now more properly called Iranian) grammars tell of the "Siyaq" figures in use by some merchants in the bazaars in Iran for keeping accounts. A. B. Antar tells me that this writing is also very occasionally employed in Mesopotamia, now called Iraq. Siyaaq, with its second vowel long, is merely the Arabic noun meaning system. The country name with vowel length indicated is Iiraan, but Iraaq. The siyaaq figures are the same as the Arabic alphabetic ones, alif equaling 1, etc., except that for 10 a corrupted contour of the written-out Arabic word for 10 is employed, instead of the Arabic letter ye, or its corruption, which is the ordinary Arabic alphabetic writing for 10.

Mixed systems.—Type 1 usually overrides types 2 and 5 in the denotation of the figures 1 to 3, inclusive, and sometimes in derivatives of these immediately above 5. Standard Chinese writes 1 to 3 by horizontal bars, merchants in China sometimes using vertical bars; Roman has vertical; Arabic has vertical for 1, yet 2 and 3 are corruptions of horizontal.

English inherits two systems of figures. These are the so-called Arabic, really merely transmitted by the Arabs to the western world from India, and the so-called Roman. The Arabic system has general application, the Roman, special and limited, functioning in the pagination of prefaces, on the clock or watch dial, or where inheritance or distinction renders its use desirable.

ORIGIN OF CLOCK-DIAL V

V is for pi, initial letter of Greek pénte, 5.—Just as the Estruscan and Latin alphabets are nothing but forms of the Greek, so the Roman figure system is merely a form of the Attic, the way of writing numerals that appears on all Athenian inscriptions. My discovery, which so far as I know has never been pointed out by anyone else, is that the V of the clock dial, meaning 5, which figure also occurs with apex up in Etruscan, is in origin an inverted Greek letter pi, standing for the Greek numeral pénte, 5.

ORIGIN OF ZERO

Zero arose through conforming, not through invention.—The second discovery announced in this paper is not to be understood without first surveying the linguistic stocks and the linguistic numeral status of India:

There are six stocks in India: 1, Dravidian; 2, Kolarian; 3, Burushaskian; 4, Aryan; 5, Tibetosinan; 6, Andamanian. Stocks 5 and 6 are too largely extraneous to warrant consideration here. Stocks 1 and 2 are upon study probably genetically related. Aryan, though it has been introduced into India from the northwest, is included because Sanskrit Aryan figures are a transmission link between Dravidian and Arab. Aryan is properly with long initial *a*, and is also and more largely called Indo-European or Indo-Germanic. Burushaskian is at present at least a small stock on the Tibetan border of northwestern India but has to be included for completeness. It will be noticed that stocks 1 and 2 carry cardinal classifiers as retrobases. This cardinal classifier in Dravidian has a u-sound, in Kolarian an i-sound. In, for instance, Tamil muu-v-ar, the 3, the u is seen to have turned into v. All the stocks of India happen to have decimal system, derived, of course, from the

human hands together having 10 fingers, and so does the Semitic stock, from the north Mesopotamian writing of which, through the Karosthi and Brahmi alphabets of ancient India, the writing of all the stocks of modern India (barring, of course, Arabic and Latin alphabet writing) is descended.

The Encylopedia Britannica, 14th edition, quotes F. Cajori in his history of mathematics as stating that zero, and the accompanying principle of position in the writing of figures, were what gave superiority to the Indic system. One finds in literature on the history of mathematics a widespread exultation over the invention of zero.

A study merely of the modern Tamil Dravidian writing of figures is enough to convince one that zero was never invented at all, but was the figure for 10. Twenty is in Tamil naturally enough written as 2-10, 30 as 3-10, etc. But 10 is never written as 1-10, since the 1 would here be considered as superfluous. When the writing of 10 became *conformed* by dint of simple analogy to resemble that of 20 and other zero-terminal decade numbers, by placing the symbol for 1 before the symbol for 10, the so-called invention of zero was attained. It was not an invention but a conformity, an accident.

RÉSUMÉ

V on the clock dial is discovered to be an inverted Greek letter pi, zero the result of a conformatory squeezing.

THE UNIT NUMERALS

Tamil (Dravidian Stock)	Mundari (Kolarian Stock)	Sanskrit (Aryan Stock)	Burushaski (Burushaskian Stock)
on^{y}d^{y}u, 1	mid', 1	éeka, 1	hik, 1
iraṇḍu, 2	bari̊a, 2	dvá, 2	aalto, 2
muun^{y}d^{y}u, 3	apia, 3	trí, 3	iiski, 3
naan^{y}gu, 4	upunia, 4	catúr, 4	waalti, 4
aindu, 5	moṇṛĕa, 5	pán^{y}ca, 5	tsindi, 5
aar^{y}u, 6	turŭia, 6	ṣáṣ, 6	mishiindi, 6
eju, 7	eea, 7	saptá, 7	tale, 7
eṭṭu, 8	íri̊lia, 8	aṣṭáa, 8	aaltambi, 8
onybadu, 9	aarĕa, 9	náva, 9	hunti, 9
THE NUMERALS 10, 11, 20, AND 21			
pattu, 10	gelea, 10	dáśa, 10	toorimi, 10
padin^{y}-on^{y}d^{y}u, 11	gel miad', 11	éekaa-daśa, 11	turma hik, 11
iru-badu, 20	hisi, also mid' hisi, 20	viṃśatí, 20	aaltər, 20
irubatt-on^{y}d^{y}u, 21	mid' hisi miad', 21	éeka-viṃśatí,21	aaltər hik, 21

BOTANY.—*Genera of the plant viruses.*[1] H. H. MCKINNEY,[2] Bureau of Plant Industry, Soils, and Agricultural Engineering. (Communicated by JOHN A. STEVENSON.)

The number of virus entities known to infect plants is well over 200. In comparison with the thousands of bacteria and fungi, this number is very small, and some workers have accordingly taken the view that there is no pressing need for a formal nomenclature and classification of the viruses at this time. Some take the view that classification should await the results of the chemists, whereas others think unnecessary confusion will prevail, even with so small a number as 200 entities, if such a policy is pursued. It is reasoned that a system can be evolved that will meet the requirements of the patholo-

[1] Received January 18, 1944.
[2] The author wishes to acknowledge the helpful advice given by John A. Stevenson, Sidney F. Blake, Charles Drechsler, and others and the assistance given by Charles Drechsler and Edith K. Cash in the choice and orthography of technical names.

gists even after the chemists may have devised a satisfactory system.

A full account of the events leading up to James Johnson's system for designating the plant viruses would require a discussion of many contributions in greater detail than seems necessary in the present paper. Investigators had been gathering evidence indicating that plants are attacked by many different viruses, but the most important stimulus probably came from the investigations of the so-called degeneration diseases of the potato, conducted by Schultz and Folsom in the United States and by Quanjer and others abroad. Schultz and Folsom's paper (1923) was greeted with much skepticism, but when subsequent studies failed to alter their conclusion that many distinct viruses may attack a given plant species it became evident that more than cursory attention should be given to the problem of virus nomenclature and classification.

James Johnson (1927) was the first to emphasize that definite steps should be taken to keep the plant viruses in order. In his scheme the major groups were erected on the basis of the hosts in which the viruses were discovered, and within each of these groups designation was by number.

Quanjer (1931) gave a critical but constructive analysis of some of the problems involved in classification, and although he concluded "that our present knowledge is insufficient for classification of plant viruses," he did divide the viruses of the potato into six categories based on the reactions they induce in selected varieties of potato. These reactions included mosaic and five types of necrosis.

Johnson and Hoggan (1935) proposed a classification based on the means of virus transmission and on the simple properties of the viruses. Later Johnson prepared his extensive lists of virus numbers in mimeographed form. One of these lists (*Illustrations of proposed system of nomenclature of plant viruses*) was prepared by Johnson (1935) as chairman of the International Committee on Descriptions and Nomenclature of Plant Viruses, for use by that committee in its deliberations at the Sixth International Botanical Congress in Amsterdam, 1935. This congress adopted Johnson's proposal in principle, and the International Committee was empowered to continue its considerations and establish an acceptable system of virus nomenclature.

Following this, Kenneth M. Smith in 1937 virtually adopted Johnson's proposal with the exception that he used the Latin generic names rather than the common names of the host plants, and he altered some of Johnson's numerical designations. In both proposals preference was given to the host in which the virus was first discovered, the several viruses assigned to a given host were differentiated by Arabic numerals, and strains were designated by letters of the alphabet. Smith made no attempt to classify within the host groups, but he did compile much valuable information on a large number of viruses and insect vectors.

With these concrete proposals came a general interest in the problem. The slight differences in the approaches by Johnson and by Smith raised several important questions in the minds of virologists, and at the meetings held in Indianapolis (December, 1937), the Council of the American Phytopathological Society appointed a committee to arrange for a discussion of the classification and nomenclature of the plant viruses at the Richmond meeting of the Society in December, 1938. At this meeting these problems were discussed from many angles, and the Society expressed its appreciation to the International Committee on Plant Viruses for the work it had done and recommended that said committee continue its efforts to establish an acceptable system of virus nomenclature (Phytopath. **29**: 388). The discussions at Richmond made it clear that opinion was divided with regard to the procedure to be followed in the naming and classifying of the viruses. It was clear that several investigators wished to explore the possibilities of technical names and of making more use of plant reactions in virus classification. It was evident also that most investigators wished to publish without restraint.

A system advanced by Holmes (1939) is particularly noteworthy in that it represents the first comprehensive attempt to make use of induced plant reactions and other virus characteristics in the framing of Latin binomials and trinomials. Holmes erected a kingdom, one division, two classes, and 11 monogeneric families. One of these families in Class I embraces the bacteriophages, whereas the 10 families in Class II embrace the viruses infecting seed plants. No orders are provided in the scheme, and none of the genera is described. Most of the species are described, but some are set up on the basis of varietal descriptions. Five of these varietal descriptions serve as types for genera.

At the meetings of the Society held in Columbus (December, 1939), the council's recommendation, "that the temporary committee on virus nomenclature be made a standing committee," was confirmed and a committee was appointed. Later, however, this committee was designated as a special committee. During 1940 the efforts of the committee were directed largely towards the orientation of the views of its members. Owing to the international situation it became apparent that there would be delay and uncertainty with respect to the efforts of the International Virus Committee, and several American workers published proposals.

Valleau (1940) classified a limited number of viruses infecting *Nicotiana tabacum* L. He set up a genus *Musivum* based on Holmes's *Marmor tabaci* var. *vulgare* as the type species, and he designated this type *Musivum tabaci*. In addition, he set up three other genera to avoid some of the heterogeneity that is evident in Holmes's genus *Marmor* and redefined the genus *Annulus*. However, he did not assign his genera to families, nor did he take a position with respect to the higher groups proposed by Holmes (1939). Valleau took the view that trinomials should not be applied to mutant strains, that there should be a "catch all" genus for viruses about which little is known, and that most of the viruses in the genus *Marmor* should be placed in it. He suggested that *Marmor* might be retained as the "catch all" genus.

Soon after Valleau's paper appeared, Fawcett (1940) proposed an ingenious plan. In his own words, "It is virtually a simplified Smith's system without the confusion of numbers and Holmes' system without the generic difficulties." Fawcett took the position that "we are not ready for genera in the ordinary concept." He proposed that the stem "vir" be added to the Latin genitive of the generic term of the host in which the virus was first discovered and recognized, dropping any final consonants that occur in this genitive. These names serve as virus genera and are identified as such by the suffix. Fawcett took the position that "these derived 'genera pro tem' should not be considered in the ordinary taxonomic sense." The specific and varietal Latin epithets are formed in accord with the established rules of botanical procedure. By this system the peach-rosette virus becomes *Prunivir rosettae* (Holmes) Fawcett.

Thornberry (1941) proposed that all viruses, bacteriophages, and the Rickettsia be placed in one order (Biovirales) in adjunct to the bacteria (class Schizomycetes, phylum Thallophyta of the Plant Kingdom). He proposed that all viruses infecting the seed plants be assigned to a single genus *Phytovirus* in a family Phytoviraceae. Other families and genera were proposed for the viruses infecting zoological species, for the Rickettsia and for the bacteriophages. Specific epithets in Latin would be formed in accordance with the established botanical procedure.

Although the Special Committee on Nomenclature and Classification of Plant Viruses was not given a specific assignment by the Society, it did proceed to study the problem with the idea of making certain recommendations. From the beginning the members seemed to be in full accord on the desirability of a formal system, and after studying the several proposals already on record a majority of the committee came to favor a Latin system of nomenclature (Bennett, et al., 1943). It was believed that a numerical system would lead to considerable difficulty on account of the chances for duplicating numbers, because slight typographical errors are more troublesome in

numbers than in names, and numbers would be more difficult to manage than names when it becomes necessary to clear up the many problems of synonymy that always arise in any field.

It was fully recognized that naming and grouping by hosts is a simple and almost fool-proof procedure and that Fawcett's (1940) proposal represents a very satisfactory and commendable way of applying Latin binomials and grouping viruses by host affinities. However, after a free discussion of the difficulties inherent in other methods of naming and grouping, a majority of the committee took the view that an understanding of virus relationships may evolve more freely if such characteristics as host reactions and modes of transmission serve as the criteria for the genera.

As the committee proceeded in its efforts to draft a proposal, it became evident that there are many details on which it is difficult to obtain agreement at this stage and that many of these details can be decided only after individual workers have had an opportunity to record their views.

GENERAL PROCEDURE

In virus classification the species, genera, families, and higher categories may not be regarded in exactly the same way as they are in the classification of higher plants and animals, but there seems to be no apparent reason why they can not serve the same purpose. The lower categories (species, genus, and family) were conceived by the early philosophers, and they have been and still are used in many departments of knowledge for classifying not only objects but also ideas and languages in various informal ways. The genus has long been regarded as a class more extensive than the species, and the family more extensive than the genus. It seems very clear that these terms denote relative levels in classification and that they may be employed in any branch of knowledge. Linnaeus and others (see Maton, 1805) made use of part or all of these categories in the classifications of minerals and also the human ailments. The Latin binomial system was also applied in these fields. Even today we have such terms as herpes zoster, herpes circinatus, herpes labiales, and molluscum contagiosum to denote certain viruses in man. With the discovery of bacteria, fungi, and Protozoa as etiological agents in disease, it is natural that classification should shift to these agents. However, there can be little doubt that Linnaeus's approach to the problem of disease nomenclature and classification could have served adequately had these etiological agents not been discovered.

In classifying the bacteria it has not been practicable to make use of morphological characteristics throughout; in fact many genera and species are determined by the reactions they induce on suitable substrates. In the fungi the differentiation of strains frequently depends on reactions induced in nutrient media or in suitable host plants, and some genera and many species have been erected on the grounds of preference for some host organ or for some host species.

Bawden (1939) and others have emphasized the high degree of variability of the induced host reactions, and they have taken the view that these reactions are of little value for purposes of virus classification. This high degree of variability is a real problem, but this fact does not necessarily mean that nothing can be done toward reducing variability to a point where host reactions can serve as adequate criteria. The use of host reactions and/or modes of transmission as criteria for virus genera or other categories seems to be a very natural step, because host reactions have long served for the common names, and something is known about means of transmission in all plant viruses. Other virus characteristics have value also, but it appears that such criteria as host range, thermal-death-point, longevity in dry tissue and *in vitro*, reactions to ordinary chemicals, serological reactions, and interference or antagonism between viruses may be of greatest value in the differentiation of species and, in some cases, strains. With the advance of knowledge concerning the histological, cytological, and physiological host reactions induced by viruses, these criteria should assume roles of increasing importance.

Johnson and Hoggan (1935) stressed the classification value of the several modes of transmission and the insect vectors, and they gave these criteria first consideration in their scheme. It is probably too early to generalize on the true value of these criteria, but it does appear that they should be given a thorough trial because certain correlations are suggested. Transmission by inoculation with expressed juice and/or by aphids is rather general among the viruses inducing mosaics, ringspots, and/or necrosis of parenchyma in annual hosts. Whereas, among the woody perennials, similar viruses can be transmitted experimentally for the most part, only through tissue unions or prolonged contact of tissues. It appears that transmission by the hoppers (leafhoppers and planthoppers) obtains in viruses that for the most part are not transmitted by other families of insects (Storey, 1939). Several compilers have indicated that certain viruses are transmitted by both hoppers and aphids, but all claims that have been noted have been checked by the present author in the original papers, and in each instance the claim lacks positive support.

In the scheme here proposed the ten families of Holmes are consolidated into two, Marmoraceae and Rugaceae. All mosaic-inducing viruses and most of those inducing necrosis in parenchyma tissue fall in the Marmoraceae and all viruses characterized by their marked tendency to induce *malformations* but not *mosaic mottling*, all those inducing the *yellows type* of *chlorosis*, and nearly all those known to induce *phloem necrosis* fall in the Rugaceae. The genus *Ruga* is taken as the type for the second family in preference to the genus *Chlorogenus*, because induced malformations seem to be commoner than chlorosis among the viruses that do not fall in Marmoraceae. The two families here proposed essentially provide the two major groups proposed by Bennett (1939).

With very few exceptions the viruses transmitted by expressed juice fall in the Marmoraceae, and with the exception of certain grass-infecting viruses that induce mosaic and/or chlorotic streaking, the hopper-transmitted viruses fall in the Rugaceae. Not all viruses transmitted by white flies are placed in the Rugaceae. The chlorotic reactions induced by the cassava-mosaic virus are typical mosaics according to the writer's observations in West Africa (McKinney, 1929). Furthermore, several mosaic-inducing viruses not transmitted by white flies also tend to induce leaf malformations. At this stage, it seems advisable to place all viruses that induce mosaic mottling in the Marmoraceae.

In the Marmoraceae the means of virus transmission serve as the generic criteria, whereas in the Rugaceae certain host reactions and also the means of transmission serve to differentiate the genera. This procedure is followed at the generic level because it appears that the use of such criteria as thermal-death-point, interference, resistance to aging, and serological reactions would cause difficulties at the species and strain levels. Eighteen genera are described from the information in Holmes's descriptions of the species and the varieties and from information gathered from other sources. Owing to the large volume of literature, however, many original papers are not cited, but reference is made to papers and compilations having extensive literature lists.

Insect vectors with chewing mouth parts are disregarded in the scheme of classification. Vectors with sucking, lapping, or rasping mouth parts, with a few exceptions noted later, are segregated on the basis of insect families. This method of segregation does increase the number of virus genera, but it appears to be one of the surest ways to obtain an objective evaluation of the criteria.

In the genus *Fractilinea* transmission by the two families of hoppers (leafhoppers and planthoppers) is combined, and in the genus *Savoia* transmission by the two families of true bugs is combined. This is done for convenience. When it is considered that members of very closely related insect families are subject to taxonomic rearrangement, it is impracticable at this stage to place a true value on some of these families as criteria for erecting separate virus genera.

It is suspected, however, that some of these insect families may serve as criteria for new virus genera later. On the other hand, it is quite possible that some of the genera may be combined later—*Ruga* and *Savoia*, for example—as certain aphids and true bugs are known definitely to transmit the virus of potato spindle-tuber and also the virus of potato unmottled curly-dwarf in the genus *Acrogenus*.

Transmission by inoculation with expressed juice is rare among the viruses transmitted by hoppers. With the curly-top virus of beet and the yellow-dwarf virus of potato, juice transmission is difficult and dependent on special hosts. In the classification of these viruses emphasis is placed on the vectors.

Viruses within a given host-reaction group that are transmitted by aphids and/or by expressed juice are placed together, and those viruses with which known transmission is limited to tissue union (grafting, budding, dodder unions) or to prolonged contact of tissues without union, are segregated in each host-reaction group in which they occur. Viruses that have been transmitted only by tissue union or by prolonged contact of tissues may be transferred to appropriate genera, or new genera may be established as the vectors are discovered or as transmission by expressed juice is effected. The 6 genera erected for these viruses fulfill the purposes of a single temporary group that was suggested by Valleau (1940). Since it is likely that a large number of viruses would be assigned to a single such group, it seems more practicable to arrange for their classification in the several host-reaction categories, as is done in the proposed scheme, because it is entirely possible that transmission by inoculation with expressed juice may not be effected. Furthermore, the vectors may not be discovered for some of these viruses for many years.

The superstructure of the scheme seems to be of relatively little importance at this time. However, the higher categories are arranged to permit the inclusion of the bacteriophages and the viruses infecting zoological species, as was planned in the scheme devised by Holmes (1939). In Holmes's scheme there are no orders, and Vira is given the rank of kingdom. Thornberry (1941) proposed that an order Biovirales be set up in the class Schizomycetes to embrace the viruses and the bacteriophages. It appears that there is some justification for assigning the viruses to the Plant Kingdom, but it seems unnecessary and unwise to contemplate redefining the Thallophytes, Fungi, and Schizomycetes to accommodate the proposed order Biovirales. In the present scheme the viruses are regarded as exceedingly low forms of life. The study of virus mutants (Holmes, 1936; McKinney, 1937 and 1941) indicates that fixed strains behave essentially as simple genic systems, and, although mutation has not been demonstrated in all viruses, it appears clear that the phenomenon occurs in several that are known to be high-molecular-weight nucleoproteins (Jensen, 1933; McKinney, 1935; Price, 1934). Furthermore, the slight differences *inter se* manifested by some of the wheat-mosaic viruses (McKinney, 1937a), the sugarcane viruses (Summers, 1934), the curly-top viruses (Giddings, 1938), and by several other viruses strongly suggest common ancestries within certain limited groups.

Since the lowest forms of life are usually included with the plants, it is proposed that the viruses be accorded the rank of *division* in the Plant Kingdom, and that this division be designated Viriphyta. It is further proposed that the procedure in virus nomenclature be governed by the International Rules of Botanical Nomenclature (Briquet, 1935) in so far as seems practicable. Subfamilial and tribal designations are purposely omitted in the present scheme.

Although certain viruses manifest natural affinities, it is believed that the plant viruses, like the fungi and other lower forms, do not represent a natural group throughout. Because of the very small number of characters available at any given group level, some of the generic descriptions are very similar with respect to the host reactions. This weakness should gradually disappear with the advance of knowledge concerning the direct characters of the viruses and the induced host reactions. Of

the latter, it appears that the cytological and microchemical reactions should become of increasing objective importance as the studies of Bennett (1940), Esau (1935), Hutchins (1933), Kassinis and Sheffield (1941), McWhorter (1941), Rawlins and Thomas (1941), Simonds and Bodine (1943), and many others are extended to additional viruses and hosts. Because of the nature of viruses, the accumulation of many coordinating and contrasting criteria at the generic level will require time.

DEFINITIONS

The term *virus* is used just as the terms *bacterium, fungus,* or *organism* are used to indicate infectious entities.

The term *strain* refers to any virus of intraspecific rank, regardless of its rank in the species.

A *species* is regarded as a group of strains, actually or potentially.

DETAILED METHODS OF PROCEDURE AND SUGGESTIONS

The International Rules of Botanical Nomenclature (Briquet, 1935) serve as the basis of procedure in the present paper, except that descriptions are not in Latin and Articles 41, 42, and 44 are not rigidly applied.

Descriptions of varieties without descriptions of the species or of the genera (Holmes, 1939 and 1941) are without precedent and create difficulties. Also, a system comprised of families, all of which are monogeneric, is without precedent. Technically all these genera and all the binomials that are based only on varietal descriptions may be regarded as *nomina nuda*. However, it appears that the best interests of virus nomenclature will not be served by a rigid application of Articles 41, 42, and 44 at this time.

Eight of Holmes's (1939 and 1941) generic names are retained and supported by descriptions based on information obtained from original sources and from Holmes's handbooks. Four of these genera, *Marmor, Lethum, Chlorogenus,* and *Acrogenus,* were founded on viruses that Holmes designated by trinomials. Although Holmes used the varietal epithets *vulgaris* and *typicus,* the procedure he followed in setting up his descriptions is not in conformity with the concept of *typicus* in relation to the specific descriptions (Ley, 1943; Croizat, 1943), and it is concluded that these four genera were founded on varieties and not on species. The writer's descriptions of these four genera are for the present regarded as emendations, and authorities are so indicated.

Valleau's (1940) description of *Musivum tabaci* is regarded as the first valid publication of the specific epithet *tabaci,* which as *Marmor tabaci* becomes a new combination and the type species of the genus *Marmor* in the present proposal. The descriptions of the type species *Lethum australiense, Fractilinea maidis, Chlorogenus callistephi,* and *Acrogenus solani* in this proposal are regarded as first valid publications. In these four species, authority for the specific epithet and authority for the description of the epithet is divided, as provided in Article 48 of the International Rules, i.e., name of the author who supplied the description being appended to the citation with the connecting word *ex.*

The following suggestions are offered:

1. The type-species concept can be applied only in a limited way to the plant viruses. As there are but few of these causal agents that can be maintained indefinitely without great expense, the burden rests on suitable descriptions and photographic records. In this proposal, no genus has been retyped. Even though some of the type species are little known, it appears that the best interests of virus nomenclature will be served if these nomenclatural types are preserved in accordance with Article 18.

2. The technical descriptions for purposes of classification should be confined to those characteristics that seem essential to proper classification. Other sources should be relied upon for the complete information on most of the viruses.

3. In the binomial system, the specific and the generic descriptions are more important than the descriptions of any of the higher categories, and even though a genus may be monotypic its characterizing features can and should be clearly set forth apart from the descriptions of the species, and the family. Each species should be designated as a binomial and be described.

4. In those genera in which transmission by tissue union is the criterion, the species should be transferred to other genera as transmission by expressed juice is effected or as insect vectors are discovered. To avoid needless changes in nomenclature it is suggested that these generic names be retained even if the type species are transferred.

5. A given virus may induce a wide range of reactions in its several suscepts, therefore, it is necessary to select the host or hosts that best characterize it.

6. The host reactions employed in the scheme are induced by viruses that are established in nature, and which may be regarded essentially as wild types. The scheme is adequate for many mutants isolated in the laboratory, but with some of these that induce indefinite reactions, the generic allocations will be determined on the basis of other suitable criteria that indicate relationship to a wild type.

7. Since so many viruses induce general dwarfing of the plant, this characteristic should be emphasized in classification only when the virus induces few other diagnostic reactions.

8. The phenomenon of compatibility and incompatibility (interference, antagonism, cross protection) between viruses may be expressed in varying degrees, depending on the viruses that are being tested, on the host, and on the environment (McKinney, 1941a). It seems unwise to assume that the phenomenon should serve as a single means for "proving" or "disproving" natural relationship between little-known viruses, but like any other character, when properly used, it may serve as a criterion for differentiating virus groups. Throughout botany and zoology there is ample evidence that the concept of relationship evolves from a knowledge of many characters at each of the levels in a particular scheme.

GENERA OF THE PLANT VIRUSES

Kingdom PHYTA

Division VIRIPHYTA

Syn.: Kingdom Vira Holmes (1939).

Causal agents of infectious diseases, ultramicroscopic in size, propagating only in association with living cells; in some cases capable of mutation and originating fixed strains that behave as simple genic systems and exceedingly low forms of life.

Class PHYTOPHAGI

Syn.: Division Phytophagi Holmes (1939).

Viruses pathogenic in plants.

Order SPERMATOPHYTOPHAGALES

Syn.: Class Spermatophytophagi Holmes (1939).

Viruses pathogenic in the seed plants.

Family 1. MARMORACEAE Holmes emend.

Annulaceae Holmes (1939); Lethaceae Holmes (1939); Rugaceae Holmes (1939) p.p.; Nanaceae Holmes (1939) p.p.

Viruses inducing disturbances of the plastid pigments causing mosaic mottling, veinbanding, discrete chlorotic spotting or streaking in the foliage; local necrotic spotting and/or systemic necrosis. Bud proliferation and malformations of the foliage are attendant reactions in some instances, but these reactions do not typify the family. All mosaic-inducing viruses fall into this family. Transmission of many species by expressed juice and/or by aphids, a few species by leafhoppers, planthoppers, or other insects, and many species by tissue union. Type genus, *Marmor* Holmes (1939) emend.

KEY TO THE GENERA

A. Transmission by expressed juice.
- *1.* Insect vectors aphids or unknown.............................Genus 1. *Marmor*
- *2.* Insect vectors thrips......Genus 2. *Lethum*

B. Transmission limited to insect vectors and/or to tissue union.[3]
- *1.* Transmission by aphids...Genus 3. *Poecile*
- *2.* Transmission by leafhoppers or planthoppers ....Genus 4. *Fractilinea*
- *3.* Transmission by white flies.............. ....Genus 5. *Ochrosticta*
- *4.* Transmission by tissue union, insect vectors unknown..........Genus 6. *Flavimacula*

[3] Throughout the keys, *transmission by tissue union* includes grafting, budding and dodder unions, and prolonged contact of cut tissues without organic union.

Genus 1. **Marmor** Holmes emend.

Marmor Holmes (1939), p.p.; *Annulus* Holmes (1939); *Musivum* Valleau (1940); *Murialba* Valleau (1940); *Foliopellis* Valleau (1940); *Tractus* Valleau (1940).

Viruses inducing disturbances of the plastid pigments and/or necrosis, especially in the parenchyma tissues, causing chlorotic mosaic mottling or spotting, oak-leaf patterns, ring spotting, local necrotic lesions, and sometimes systemic necrosis; malformations and/or bud proliferations sometimes accompanying the chlorotic reactions; sometimes disturbances in the glucoside pigments, especially in certain graminaceous hosts, causing purple and red colorations. Transmission by expressed juice in all members; insect vectors aphids (Aphididae) or unknown. Type species, *Marmor tabaci.*

Marmor embraces most of the species inducing the typical mosaics and the ringspots, nearly all the species that can be studied outside the plant, and all species known to be nucleoproteins. Most of the suscepts are herbaceous annuals.

Marmor tabaci (Holmes ex Valleau), comb. nov.

Tobacco virus 1 Johnson (1927); Nicotiana virus 1 Smith (1937); *Marmor tabaci* var. *vulgare* Holmes (1939); *Musivum tabaci* (Holmes ex Valleau) Valleau (1940).

Common name.—Tobacco-mosaic virus.

Host reactions.—In *Nicotiana tabacum* L. var. Samsun (Turkish) and most other commercial varieties of tobacco, *N. sylvestris* Spegaz. and Comes, *Lycopersicon esculentum* Mill. var. Bonny Best, and other commercial varieties of tomato, virus increase is very great and induces conspicuous light-green mosaic mottling at all the usual culture temperatures; in the tobaccos the reactions manifest acute and chronic types (McKinney and Clayton, 1943), especially under field culture when acute burning occurs in var. Maryland Medium Broadleaf and certain other varieties; virus content of leaves with acute chlorosis higher than in leaves with chronic mosaic. In *N. glutinosa* L. and *N. rustica* L., induces local necrotic lesions, systemic necrosis or mosaic mottling when cultured at 24°, 31°, or 37° C., respectively. In *Plantago major* L. secondary symptoms are feeble or null. In certain collections of *N. tabacum* from Colombia (derivatives from Ambalema tobacco and T.I. 448 tobacco, McKinney, 1943), and in *N. glauca* R. Grah., virus increase is very low, inducing only occasional chlorotic spots or no visible reactions. *Cucumis sativus* L. is immune. This species has a very wide host range.

Transmission.—Readily by inoculation with expressed juice in the suscepts listed, by the following aphids (Aphididae): *Macrosiphum gei* Koch, *Myzus pseudosolani* Theob., and *M. circumflexus* (Buckt.), after feeding on infected *Lycopersicon esculentum;* by tissue union (grafting and dodder).

Mutation.—All field collections of the species (wild types) are very similar but not identical in all hosts; all collections that have been studied have given rise to aberrant types. Interference or antagonism (protection) has occurred in all tests thus far in which wild types were in combination with their known mutants, and the wild types have always dominated and supplanted the mutants in the new tissues. Combinations of these mutants, also combinations of *Marmor tabaci* and certain other virus species, have shown that interference is definitely a quantitative phenomenon that is influenced by the viruses in combination, by the host and by the external environment (McKinney, 1941a).

Physical and chemical properties.—The type virus and the strongly invasive strains tested thus far are inactivated at 88° to 93° C. in 10 minutes in plant juices; activity not lost completely after storage for many years in dry tissue or plant extract at room temperature; dilution end-point in fresh plant extract from mosaic tobacco 1,000,000 × or beyond; ultimate particle (micelle or molecule) rod shaped with a minimal diameter of particles about 11.5mμ; paracrystals at p_H 4.5, length 3.2 to 4.2μ, width 0.4 to 0.5μ; high molecular-weight nucleoproteins; possessing antigenetic properties that distinguish it from other virus species, and that serve to distinguish between some but not all its strains.

Distribution.—World wide with tobacco culture.

Type virus.—James Johnson, University of Wisconsin, Madison, Wis.; Rockefeller Institute for Medical Research, Department of Animal and Plant Pathology, Princeton, N. J.;

H. H. McKinney, U. S. Bureau of Plant Industry, Soils, and Agricultural Engineering, Beltsville, Md.

Genus 2. **Lethum** Holmes emend.

Viruses inducing disturbances causing bronzing, chlorotic and necrotic spotting, and ringspotting in foliage; in some hosts typical mosaic mottling; severe necrosis and death in certain hosts; distortion and curling of leaves sometimes as attendant reactions. Transmission by expressed juice; all species transmitted by thrips (Thripidae). Type species, *Lethum australiense.*

Lethum australiense Holmes[4]

Tomato virus 1 Johnson (1935); Lycopersicon virus 3 Smith (1937); *Lethum australiense* var. *typicum* Holmes (1939).

Common name.—Tomato spotted-wilt virus.

Host reactions.—In *Lycopersicon esculentum* Mill. var. Bonny Best and other commercial varieties of tomato, induces a bronze coloration necrosis, and sometimes mottling; bronzing involving entire surface of leaflet or occurring as rings, which become necrotic; necrosis first involving the upper epidermal cells, then the spongy parenchyma; systemic necrosis sometimes killing plants when infected as seedlings; pale red, yellow, or white blotching on ripe fruit, sometimes involving most of surface. In *Nicotiana tabacum* L. var Samsun (Turkish), and var. White Burley, induces local necrotic lesions or plaques on the inoculated (wiped) leaves; necrosis sometimes systemic and fatal to the plant or to all leaves except those in the growing tip; sometimes systemic mottling. In *Petunia* sp. (garden varieties) local reddish-brown lesions with pale centers; rarely systemic.

In *Nicotiana glutinosa* L. local necrotic lesions that become larger than those induced by *Marmor tabaci;* systemic necrosis and death of plant in some cases. In *Datura stramonium* L. concentric-ring spotting, necrotic oak-leaf patterns; typical mosaic mottling, especially during summer season. In *Pisum sativum* L. (garden varieties) systemic necrotic streaks in stem and veins of leaflets; sometimes local necrotic spots on wiped leaflets; necrosis involving parenchyma tissue and phloem; sometimes a mottled pattern on leaves infected when young. In *Ananas sativus* L. induces the yellow-spot disease (Hawaii); in *Nicotiana tabacum* the "vira-cabeca" (Brazil); in *N. tabacum* and *Lycopersicon esculentum* the "kromneck" disease (So. Africa); in *N. tabacum* the "corcova" disease (Argentina), and in *L. esculentum* the tip-blight disease (Oregon and W. Virginia)—the causal agents, if not identical with *Lethum australiense*, appear to be strains. Collections of this virus or its strains that have been observed in tobacco by the author, induced reactions that were strikingly similar to those induced by the tobacco ringspot virus. *L. australiense* has a very wide host range.

Transmission.—By inoculation with expressed juice wiped on leaves dusted with fine carborundum dust, grain 600 or equal; by the following thrips (Thripidae): *Thrips tabaci* Lind., *Frankliniella paucispinosa* Moult., *F. moultoni* Hood, *F. lycopersici* Andr., and *F. occidentalis* Perg.

Physical and chemical properties.—Inactivated at temperatures near 42° C. in 10 minutes in plant juices; in a few hours at room temperatures in plant juices or in drying itssue. Dilution end-point between 10,000 and 100,000 ×. Passes Gradocol membrane with pore diameter of 450 mμ.

Distribution.—Australasia, United States, Great Britain, probably Hawaii, South Africa, and South America.

Genus 3. **Poecile,** gen. nov.

Marmor Holmes (1939) p.p.

Viruses inducing disturbances of the plastid pigments causing mosaics, marginal yellowing, of yellow patching in foliage; in some cases bud proliferation and leaf malformations are attendant reactions. Transmission by expressed juice not typical, null or exceedingly difficult; all species transmitted by aphids (Aphididae). Name from Latin meaning variegation (fem.). Type species, *Poecile rubi.*

Poecile rubi (Holmes), comb. nov.

Raspberry virus 2 Johnson (1935); Rubus virus 1 Smith (1937); *Marmor rubi* Holmes (1939).

Common name.—Raspberry-mosaic virus.

Genus 4. **Fractilinea,** gen. nov.

Marmor Holmes (1939) p.p.

Viruses inducing disturbances of the plastid

[4] For citation of authority see p. 145, col. 2, par. 1.

pigments causing pale green to yellow or almost white opaque or translucent streaks (continuous or broken), spotting or speckling; bud proliferation (rosetting) and marked general dwarfing in some cases. Transmission by expressed juice not typical, null or exceedingly difficult; all species transmitted by leafhoppers or planthoppers (Cicadellidae or Fulgoridae). Name from two Latin words signifying *interrupted* and *line* (fem.), referring to the broken chlorotic lines and streaks induced in the leaves. Type species, *Marmor maidis.*

Fractilinea maidis (Holmes),[5] comb. nov.

Corn virus 2 Johnson (1935); Zea virus 2 Smith (1937); *Marmor maidis* var. *typicum* Holmes (1939).

Common name.—Maize (corn)-streak virus.

Host reactions.—In *Zea mays* L. and *Saccharum officinarum* L. var. Uba. induces light-green spots, broken and continuous chlorotic streaks. On the latter host the reactions are milder and the virus does not persist in the new foliage.

Transmission.—By the following leafhoppers (Cicadellidae): *Cicadulina* (*Balclutha*) *mbila* (Naudé), *C. storeyi* China, and *C. zeae* China; not by inoculation with expressed juice. *Cicadulina mbila* is heterozygous for the virus-transmission character, and this character is sex linked. No morphological characters have been found that distinguish the race that transmits from the one that cannot transmit virus. Presumably the difference is in the permeability of the intestinal wall.

Mutation.—Not demonstrated. *Marmor maidis* var. *sacchari* Holmes (1939) and *M. maidis* var. *mite* Holmes (1939) are similar to *Fractilinea maidis,* but it is largely a matter of opinion as to their rank. They may represent strains of *F. maidis* or they may be closely related species.

Physical properties.—Virus passes a Chamberland L_3 filter but is retained by the Seitz E. K. filter disk when the p_H is near 6.

Distribution —Africa.

Genus 5. **Ochrosticta,** gen. nov.

Ruga Holmes (1939) p.p.

Viruses inducing mosaic mottling. Leaf deformations and bud proliferations sometimes attendant reactions, but these do not characterize the genus. Transmission by expressed juice null; all species transmitted by white flies (Aleyrodidae). Name from two Greek words meaning *yellow* and *dapple* (fem.), referring to the chlorotic mottling reaction. Type species, *Ochrosticta bemisiae.*

Ochrosticta bemisiae (Holmes), comb. nov.

Manihot virus 1 Smith (1937); *Ruga bemisiae* Holmes (1939).

Common name.—Cassava-mosaic virus.

Genus 6. **Flavimacula,** gen. nov.

Marmor Holmes (1939) p.p.; *Nanus* Holmes (1939) p.p.

Viruses inducing disturbances of the plastid pigments causing chlorotic and/or necrotic spotting and sometimes mosaics with attendant rosetting of leaves; a few species inducing disturbances of the glucoside pigments, but no striking bud proliferation; malformations such as leaf curling, etc., sometimes are attendant reactions. Experimental transmission limited to tissue union; insect vectors not known. Name from two Latin words meaning *yellow* and *spot* or *smear* (fem.), referring to the chlorotic spotting or mottling reaction. Type species, *Flavimacula persicae.*

Flavimacula persicae (Holmes), comb. nov.

Peach virus 6 Johnson (1935); Prunus virus 5 Smith (1937); *Marmor persicae* Holmes (1939).

Common name.—Peach-mosaic virus.

Many members of this genus have rosaceous hosts, relatively few typical mosaic patterns are induced and little is known concerning properties other than host reactions and the mode of transmission.

Family 2. RUGACEAE Holmes emend.

Nanaceae Holmes (1939) p.p.; Coriaceae Holmes (1939); Savoiaceae Holmes (1939); Marmoraceae Holmes (1939) p.p.; Chlorogenaceae Holmes (1939); Acrogenaceae Holmes (1939) and Gallaceae Holmes (1939).

Viruses inducing cellular disturbances causing various malformations such as bud proliferation (rosetting or brooming), thickening of tissues, enation, leaf curl, galls, cortical lesions (cankers), vascular proliferation and/or dwarfing. Phloem necrosis induced by some members

[5] See footnote 4.

(necrosis sometimes extending well into the parenchyma). Many members not inducing striking attendant disturbances of the plastid or glucoside pigments; pigment disturbances when evident usually involving entire leaves or diffuse patches causing the yellows type of chlorosis, and not mosaic; some species tending to induce intensification of green coloration. Transmission frequently limited to tissue union and/or to insect vectors; few species transmitted by inoculation with expressed juice. Type genus, *Ruga* Holmes (1939) emend.

KEY TO THE GENERA

A. Viruses inducing bud proliferation causing brooming or rosetting; sometimes dwarfing reactions.
- *1.* Viruses inducing pigment disturbances in foliage
  - *a.* Transmission by leafhoppers.......... ....Genus 1. *Chlorogenus*
  - *b.* Transmission by tissue union, insect vectors not known. Genus 2. *Chlorophthora*
- *2.* Induced pigment reactions null, inconspicuous or inconstant.
  - *a.* Transmission by aphids................ ....Genus 3. *Blastogenus*
  - *b.* Transmission by tissue union, insect vectors not known....Genus 4. *Polycladus*

B. Viruses inducing chiefly malformations of foliage as curling, crumpling, rolling, perforation, laceration, enations, galls, dwarfing; maldevelopment and/or malformation of fruit; general dwarfing of plant usually an attendant reaction. Virus-induced proliferation null or inconstant; general chlorosis and/or accentuation of glucoside pigments induced by a few members, but not a characteristic of the group.
- *1.* Transmission by aphids...Genus 5. *Corium*
- *2.* Transmission by true bugs. Genus 6. *Savoia*
- *3.* Transmission by leafhoppers or planthoppers ....Genus 7. *Galla*
- *4.* Transmission by white flies..Genus 8. *Ruga*
- *5.* Transmission by tissue union, insect vectors not known.......Genus 9. *Carpophthora*

C. Viruses characterized by their reactions in and near cortex of the trunk and branches; reactions in other parts null or of low diagnostic value.
- *1.* Transmission by tissue union, insect vectors not known........Genus 10. *Rimocortius*

D. Viruses inducing general dwarfing of host or its parts; green coloration of foliage frequently intensified; other reactions null or of low diagnostic value.
- *1.* Transmission by expressed juice, vectors aphids and/or true bugs or not known ....Genus 11. *Acrogenus*
- *2.* Transmission by tissue union, insect vectors not known...........Genus 12. *Minuor*

Genus 1. **Chlorogenus** Holmes emend.

Chlorogenus Holmes (1939) p.p.

Viruses inducing bud proliferation causing brooming or rosetting of shoots or leaves; malformation and dwarfing of leaves; pigment disturbances causing general yellowing or diffuse yellowish patching of foliage; disturbances of glucoside pigments sometimes causing reddening and purpling of foliage. No typical mosaic mottling. Transmission by expressed juice null or too difficult for purposes of classification; all species transmitted by leafhoppers (Cicadellidae). Type species, *Chlorogenus callistephi.*

Chlorogenus callistephi Holmes[6]

Callistephus virus 1 Smith (1937); *Chlorogenus callistephi* var. *vulgaris* Holmes (1939).

Common name.—Aster-yellows virus.

Host reactions.—In *Callistephus chinensis* Nees. stimulates lateral bud and side-shoot development; shoots slender, wiry and upright, tending to have long internodes; shortening of main-stem internodes; leaves narrow, deformed and upright; induces general chlorosis, especially in young tissues (leaves, petioles, stem, and branches); sectorial chlorosis occurring in some leaves, but never mosaic mottling; floral straps becoming virescent, and their trichomes frequently developing into leaflike structures; mild necrosis usually appearing just below apex of the stem, flowers usually sterile. The stimulation of buds with the development of side shoots is somewhat more constant than the chlorotic reaction among the many susceptible host species.

Transmission.—By the leafhopper (Cicadellidae) *Macrosteles divisus* (Uhl.); by grafting; not by inoculation with expressed juice.

Physical properties.—Inactivated in the insect vector in 12 days at 31° C.

Distribution.—United States; Canada, Bermuda, Hungary, and Japan.

Genus 2. **Chlorophthora,** gen. nov.

Chlorogenus Holmes (1939) p.p.; *Nanus* Holmes (1939) p.p.

Viruses inducing bud proliferation causing brooming of twigs or rosetting of leaves, chlorosis or bronzing, malformation and dwarfing of foliage, malformation and sometimes in-

[6] See footnote 4.

tensification of color in fruit. Experimental transmission limited to tissue union; insect vectors not known. Name from two Greek words meaning *green* and *destruction* (fem.) referring to the destruction of chlorophyll induced in the foliage. Type species, *Chlorophthora solani.*

Chlorophthora solani (Holmes), comb. nov.

Potato virus 11 Johnson (1935); Solanum virus 15 Smith (1937); *Chlorogenus solani* Holmes (1939).

Common name.—Potato witches'-broom virus.

Genus 3. **Blastogenus,** gen. nov.

Nanus Holmes (1939), p.p.

Viruses inducing bud proliferation causing brooming or rosetting of twigs or leaves without striking chlorosis. Transmission by expressed juice null or too difficult for purposes of classification; all species transmitted by aphids (Aphididae). Name from two Greek words signifying *bud* and *producing* (masc.), referring to the large number of buds activated. Type species, *Blastogenus fragariae.*

Blastogenus fragariae (Holmes), comb. nov.

Strawberry virus 2 Johnson (1935); Fragaria virus 3 Smith (1937); *Nanus fragariae* Holmes (1939).

Common name.—Strawberry witches-broom virus.

Genus 4. **Polycladus,** gen. nov.

Chlorogenus Holmes (1939) p.p.; *Galla* Holmes (1939) p.p.; *Nanus* Holmes (1939) p.p.

Viruses inducing bud proliferations causing brooming or rosetting of twigs, leaves or floral parts; no striking chlorosis; malformations and/or dwarfing of leaves. Experimental transmission limited to tissue union; insect vectors not known. Name from two Greek words signifying *many shoots* or *branches* (masc.), referring to the excessive number of shoots induced. Type species, *Polycladus robiniae* Holmes (1939).

Polycladus robiniae (Holmes), comb. nov.

Robinia virus 1 Smith (1937); *Chlorogenus robiniae* Holmes (1939).

Common name.—Locust witches'-broom virus.

Genus 5. **Corium** Holmes (1939)

Corium Holmes (1939); *Nanus* Holmes p.p. (1939).

Viruses inducing foliar malformations as rolling, puckering, wrinkling, dwarfing etc.; some species inducing mild general chlorosis in the leaves; no consistently striking bud proliferation. Transmission by expressed juice null or too difficult for purposes of classification; all species transmitted by aphids (Aphididae). Type species, *Corium solani.*

Corium solani Holmes (1939)

Potato virus 1 Johnson (1935), Solanum virus 14 Smith (1937).

Common name.—Potato leaf-roll virus.

Genus 6. **Savoia** Holmes (1939)

Viruses inducing foliar malformations as wrinkling, twisting, curling, dwarfing, etc.; phloem necrosis in roots and premature death of host in some cases; chlorosis when evident is diffuse, not typical mosaic. Transmission by expressed juice in some cases, but with difficulty; all species transmitted by true bugs (Tingitidae or Miridae). Type species, *Savoia betae.*

Savoia betae Holmes (1939)

Sugar-beet virus 3 Johnson (1935); Beta virus 3 Smith (1937).

Common name.—Beet leaf-curl virus.

Genus 7. **Galla** Holmes (1939)

Marmor Holmes (1939), p.p.; *Chlorogenus* Holmes (1939), p.p.; *Galla* Holmes (1939), p.p.

Viruses inducing malformations of foliage as curling, rolling, cupping, crumpling, galls; degeneration or necrosis of the phloem sometimes extending well into the parenchyma tissues; chlorosis (not mosaic mottling) and/or bud proliferation in some hosts but chlorosis and proliferation do not characterize the genus. Transmission by expressed juice null or too difficult for purposes of classification; all species transmitted by planthoppers (Fulgoridae) or by leafhoppers (Cicadellidae). Type species *Galla fijiensis.*

Galla fijiensis Holmes (1939)

Sugar-cane virus 2 Johnson (1935); Saccharum virus 2 Smith (1937).

Common name.—Sugarcane Fiji-disease virus.

Genus 8. **Ruga** Holmes (1939)

Ruga Holmes (1939), p.p.

Viruses inducing foliar malformations as rolling, puckering, wrinkling, dwarfing, etc.; thickening of veins; mild chlorosis (not mosaic mottling) in some cases but this reaction is too inconstant for purposes of classification. Transmission by expressed juice null or too difficult for use in classification; all species transmitted by white flies (Aleyrodidae). Type species *Ruga tabaci.*

Ruga tabaci Holmes (1939)

Tobacco virus 16 Johnson (1935); Nicotiana virus 10 Smith (1937).

Common name.—Tobacco leaf-curl virus.

Genus 9. **Carpophthora,** gen. nov.

Marmor Holmes (1939) p.p.

Viruses inducing foliar malformations as twisting, enations, warts, rolling, folding, puckering, tattering, perforation; early drop of leaves and fruit in some hosts; maldevelopment and malformations in fruit in some cases without reactions in foliage; some members inducing yellowing and reddening or purpling of foliage, bark cankers, phloem necrosis, twig die-back and sometimes death of tree; bud proliferation null or not a striking characteristic, and not typifying the genus. Experimental transmission limited to tissue union; insect vectors not known. Name from two Greek words signifying *fruit* and *ruin* or *destruction* (fem.). Type species, *Carpophthora lacerans.*

Carpophthora lacerans (Holmes), comb. nov.

Marmor lacerans Holmes (1939).

Common name.—Peach X or yellow-red-disease virus (Hildebrand et al. 1942).

If this virus, sweet-cherry buckskin-disease virus (Rawlins and Thomas, 1941), and peach-leaf-casting-yellows virus (Thomas, Rawlins, and Parker, 1940) are identical, consideration should be given to the common name "buckskin disease," which antedates the other names. (See the literature lists in Hildebrand et al., 1942.)

Genus 10. **Rimocortius** Milbrath and Zeller (1942)

Viruses inducing reactions chiefly in the cortical region of woody stems and branches causing swelling, scaling, cracking, checking, splitting, cankering, and/or gumming; splitting and crosscracking of the midribs of leaves, causing leaf curling in some instances. Chlorosis absent or not striking, sometimes vein clearing or stippling, but not typical mosaic mottling. Experimental transmission limited to tissue union or possibly to prolonged contact of tissue without organic union; insect vectors not known. Type species, *Rimocortius kwanzani.*

Rimocortius kwanzani Milbrath and Zeller (1942)

Common name.—Flowering-cherry rough-bark virus.

Host reactions.—In *Prunus serrulata* Lindl. var. *Kwanzan*, induces longitudinal and transverse splitting, and deep brown coloration of the bark; shortening of stem internodes and clustering of leaves; downward arching or curling of leaves, with frequent longitudinal and transverse cracking of the underside of the midribs; general dwarfing of the tree and reduced number of lateral branches. No definite chlorotic reactions in foliage. Wild *P. avium* L. (Mazzard) is a symptomless carrier of the virus. Other varieties of *P. serrulata* apparently are immune.

Transmission.—By budding and grafting; organic union need not be sufficient for bud development (possibly a prolonged contact of tissues without organic union is sufficient to effect transmission). No insect vectors have been found.

Distribution.—Oregon.

Genus 11. **Acrogenus** Holmes emend.

Viruses inducing a general dwarfing of plants and/or foliage; chlorosis; rolling and wrinkling of foliage null or slight, intensification of green coloration of foliage a common reaction. Transmission by expressed juice in all species; insect vectors aphids (Aphididae) and/or true bugs or not known. Type species, *Acrogenus solani.*

Acrogenus solani Holmes[7]

Potato virus 8 Johnson (1935); Solanum virus 12 Smith (1937); *Acrogenus solani* var. *vulgaris* Holmes (1939).

Common name.—Potato spindle-tuber virus.

Host reactions.—In *Solanum tuberosum* L., induces delayed emergence; stiff, spindly, erect

[7] See footnote 4.

stems; small, erect, dark-green leaves with slender brittle petioles; twisted terminal leaves; elongated, cylindrical, tapered tubers with irregular contour, smooth tender skin and prominent eyes, flesh of tubers brittle at harvest, but softer than normal after storage.

Transmission.—By inoculation with expressed juice, by aphids (Aphididae), *Myzus persicae* (Sulz.) and *Macrosiphum gei* Koch; tarnished plant bug (Miridae), *Lygus pratensis* L., also by certain chewing insects, grasshoppers (Locustidae), *Melanoplus* spp.; flea beetles (Chrysomelidae), *Epitrix cucumeris* Harris and *Systena taeniata* (Say); leaf beetles (Chrysomelidae), *Disonycha triangularis* (Say), and Colorado potato-beetle larvae (Chrysomelidae) *Leptinotarsa decemlineata* Say.

Geographic distribution.—United States and Canada.

Genus 12. **Minuor** Zeller and Braun (1943)

Nanus Holmes p.p.

Viruses inducing general dwarfing or stunting of the plant as a whole or its parts; some species inducing intensification of green coloration of the foliage. Malformation and chlorosis absent or of little diagnostic value. Experimental transmission limited to tissue union; insect vectors not known. Type species: *Minuor ruborum.*

Minuor ruborum Zeller and Braun (1943)

Common name.—Raspberry decline-disease virus.

Host reactions.—In *Rubus idaeus* L. var. Cuthbert, when infection occurs late in the season, virus retards growth of new shoots and intensifies their reddish color the following spring. In the field the leaves on these canes show no symptoms until growth slows down in the autumn, when they roll downward and become fluted along the veins; leaves toward the cane tips show very slight chlorosis between the veins and a slight bronzing along the margins and crests between the veins; the cane internodes toward the tip are shortened. In greenhouse culture the downward rolling of the leaves is evident throughout the growing season. In the field, infected canes are small and weakened as evidenced by winter killing or failure of lateral buds; the feeder rootlets become reduced and the whole plant deteriorates progressively until death, which occurs at a maximum of about 3 years after infection. The berries are globose and the druplets separate readily, rendering the fruit worthless. Infection spreads from a diseased-plant center causing spotted areas that may be over 200 feet in diameter. Other varieties of *R. idaeus* and other species of *Rubus* have shown reactions resembling those induced by the decline-disease virus in the Cuthbert variety. All attempts to isolate and culture a parasite have failed.

Transmission.—By grafting; insect vectors not known.

Distribution.—Willamette Valley, Oreg.; possibly British Columbia.

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ZOOLOGY.—*Notes on a small collection of reptiles and amphibians from Tabasco, México.*[1] Hobart M. Smith. (Communicated by Herbert Friedmann.)

Walter A. Weber, of the U. S. National Museum, naturalist to the Fifth National Geographic Society–Smithsonian Institution Expedition to southern México, under the leadership of Matthew W. Stirling, collected a small series of reptiles and amphibians near the base camp at La Venta, Tabasco. The material, now a part of the collections of the U. S. National Museum, was obtained in March and April, 1943. It was made available to me for study through the courtesy of Dr. Alexander Wetmore. It contains 12 specimens of nine species, five of which have not previously been recorded from the state of Tabasco, while one has not been collected for more than 50 years

[1] Received January 11, 1944.

and is among the great rarities of the Mexican herpetofauna.

La Venta is a heavily forested island about 4 miles across by 1½ miles wide located in the coastal swamps near the mouth of the Tonalá River, in the angle formed by the junction of that stream with the Río Blasillo. This point is about 15 miles inland to the southeast of the town of Tonalá on the Gulf coast.

Eleutherodactylus rhodopis (Cope)

A single specimen (U.S.N.M. 117556) was obtained on April 7. It is half grown and measures 25.3 mm from snout to vent. The markings and pattern of ridges are typical of the Atlantic coast specimens of the species.

This species has not previously been recorded from the state of Tabasco, although its existence there has been indicated by records from adjacent areas.

Agalychnis callidryas (Cope)

Two specimens (U.S.N.M. 117557–117558) were collected on March 24. They are immature, measuring 24 mm from snout to vent. The diagonal lateral cream lines are clearly evident in each. One is bright purple above, while the other has a strong gray suffusion nearly obliterating the purple color.

There are no records of this species in the literature for the state of Tabasco.

Anolis bourgaei Bocourt

A single specimen (U.S.N.M. 117348) is referred to this species, following the nomenclature proposed by Schmidt (Publ. Field Mus. Nat. Hist., Zool. Ser., **22**: 491. 1941). It is a subadult male, with lateral light stripes.

The species has not previously been recorded from Tabasco.

Laemanctus deborrei Boulenger

One of the most valuable items secured is a specimen (U.S.N.M. 117349), collected on April 12, that proves to be the second known from México (the type is from "Tabasco") and perhaps the only one of the species in any American museum. It is a fine adult female carrying five eggs that average 26 by 15 mm in size. The snout-vent length is 120 mm, the tail 458 mm, the snout-occiput length (measured along the flat dorsal surface of the head) 41 mm.

The scales on the snout are not, or scarcely, larger than those in the occipital region; no prominently projecting scales on posterior edge of occiput; dorsal head scales strongly rugose, lateral head scales weakly rugose; about six canthals, the anterior in contact with first supralabial; one prenasal between first canthal and nasal; latter in contact with canthal series above and with supralabials (second and third) below; numerous loreal scales, a maximum of four in a vertical row from loreals to supralabials; five or six small suboculars, three or four in contact with supralabials; lores sloping *inward* slightly, as viewed from above; 11–12 supralabials; 11–11 infralabials; mental half as wide as rostral; gular scales weakly polycarinate, 21 in a row from mental to gular fold. Scales around middle of body 48; nape scales (sides and back) smooth; middorsal scales rather strongly keeled, especially just back of nape; paravertebral scales feebly polycarinate, becoming smooth in dorsolateral region; lateral scales feebly uni-, bi-, or tricarinate; belly scales rather strongly unicarinate. Dorsal scales on forelimb bi- or tricarinate, those on hindlimb (except foot) unicarinate; ventral limb scales unicarinate. Tail scales unicarinate, feebly above, strongly below. One of the most curious features in the scutellation of the species is the absence of keels on the subdigital lamellae—a character common to practically all iguanids. In their stead is a very curious, swollen, yellow or dark-brown knob in the middle of each lamella at its distal (free) edge. I know of no similar feature in other genera of iguanids, although it may occur in the related *Corythophanes*.

The coloration in life may well be much different from that seen in preserved specimens. Where the scales have been lost, the color is of various shades of purple; nine rather poorly defined, subrectangular, dark yellow spots about four scale rows wide form a vertebral series on the body, continuing dimly on the tail; the rest of the dorsal surfaces are of a dark wine color, the ventral surface a curious, striking, bright yellowish purple. The head is yellowish brown above and on the sides has scattered, purplish, greenish and yellowish

areas blending into one another. The posterior edges of the occipital shelf are black.

Ameiva undulata stuarti Smith

A single specimen (U.S.N.M. 117350) is apparently typical of this subspecies. The median gulars are in a single row, the largest larger than any mesoptychial or preanal; the preanals are in two rows; the femoral pores are 21–21, and the subdigital lamellae of the fourth toe are 30–32.

Apparently there is no previous record of the occurrence of this widely distributed species in Tabasco.

Ninia sebae sebae (Duméril and Bibron)

Three specimens (U.S.N.M. 117352–117354) were collected April 3 to 7. Respectively these have 138(♂), 133(♀), 134(♂) ventrals; 53, 44, 50 caudals; 6–6, 7–7, 7–7 infralabials; and 1–1, 2–2, 2–2 postoculars. The supralabials are 7–7 in all, temporals 1–2–3. The number of caudals in all three is less than is typical of *s. sebae*, with a total range of caudals from 51 to 71 in males and 40 to 60 in females; most males have over 54, most females over 45. In this character the specimens approach *s. morleyi*, in which the males usually have less than 54 (range 44 to 54), the females usually less than 45 (38 to 46). The three can not be referred to *s. morleyi*, however, for the known minimum ventral count for that race is 143 in females, 137 in males. It is not unreasonable to assume that the Tabasco specimens represent an intergrading population that still retains greater affinities to *s. sebae*.

Pliocercus elapoides elapoides Cope

A single specimen (U.S.N.M. 117351) of this subspecies, collected on April 17, is of considerable interest, since it represents an area from which the species is otherwise unknown. It is a female measuring 234 mm in total length, the tail 89 mm. The ventrals number 130, the caudals 97; supralabials 8–8; infralabials 9–9; preoculars and postoculars 2–2; temporals 1–1. The outer rings of each triad of black rings are much broader than the yellow rings; 12 primary black rings are on the body, 10 on the tail; and five of the anterior six black rings are incomplete ventrally.

The broad, secondary black rings, 9–9 infralabials, and 130 ventrals are characters that conclusively allocate this specimen with the typical race, although all other known specimens from Tabasco are clearly referable to *e. laticollaris*. The incomplete black rings, however, demonstrate an approach toward *e. laticollaris*. The Tabasco localities for the latter race (Macuspana, Teapa, Tenosique) are in the central and western part of the state and, moreover, are in or very near the foothills of the Atlantic escarpment. Intergradation between these two races is indicated for the area between La Venta, in extreme western Tabasco near the coast, and Teapa, located near the foothills of central southern Tabasco. Fairly typical *e. elapoides* may occur much farther eastward, however, near the coast.

As implied above, this specimen affords the first record of the occurrence of *e. elapoides* in Tabasco.

Coniophanes fissidens fissidens (Günther)

A male (U.S.N.M. 117555), collected on April 2, has 21–17 scale rows, 117 ventrals, incomplete tail, and 8–8 supralabials. The median border of the dorsolateral light stripes is indistinct in front of the anus, and the light stripes are visible on the neck. A dark spot near the end of each ventral is somewhat larger than other, scattered, black flecks. Though showing an approach toward *f. proterops*, especially in ventral markings, the specimen is clearly most like *f. fissidens*. It is noteworthy that La Venta specimens of this species show southern (eastern) affinities, while those of *Pliocercus* show northern (western) affinities.

Bothrops atrox (Linnaeus)

A single specimen (U.S.N.M. 117355) was collected on April 7. It is a half-grown female with 210 ventrals, 61 caudals, and 25–27–21 scale rows.

ZOOLOGY.—*Additional notes on Foraminifera in the collection of Ehrenberg.*[1]

J. A. Cushman, Sharon, Mass.

In the summer of 1927 a visit was made to study the Foraminifera in the Ehrenberg collection in Berlin to determine if possible the characters and relationships of the numerous genera erected by Ehrenberg between 1838 and 1872. Notes on some of these have already been published in this Journal **17**: 487–491, 1927. As noted previously, there are many excellent original drawings that were never published which, with the specimens themselves, serve to give the characters needed to determine the systematic position of these genera. Notes are here given on a number of these genera and their probable relationships.

Asterodiscus Ehrenberg, 1838 (Abh. Akad. Wiss. Berlin, 1838: 130). The genoholotype is *A. forskålii* Ehrenberg but is not figured. The type is from Santo Domingo and is the common species of that region. It should be placed as a synonym of *Planorbulina* d'Orbigny, 1826, and the species a synonym of *P. mediterranensis* d'Orbigny.

Omphalophacus Ehrenberg, 1838 (Abh. Akad. Wiss. Berlin, 1838: 132). The first species is *O. hemprichii* Ehrenberg (*l. c.*, p. 132). There are two lots of specimens in the Ehrenberg collection labeled "Tor" and "Erraia," respectively, but nothing more as to locality. They represent an unequally bilateral species of *Amphistegina*. The later species, *O.? tenellus* Ehrenberg (Mikrogeologie, 1854: pl. 32, pt. 2, fig. 34), was not found in the collection and is very difficult to determine from the figure. Its relationship was questioned by Ehrenberg himself. Therefore the genus *Omphalophacus* may be placed as a synonym of *Amphistegina* d'Orbigny, 1826.

Geoponus Ehrenberg, 1839 (Abh. Akad. Wiss. Berlin, 1839: 132). The genoholotype is *G. stella-borealis* Ehrenberg (*l. c.*, p. 132, pl. 1, figs. *a–g*). The type specimens are from living material from off Cuxhaven. In the Ehrenberg collection are excellent original figures in color showing pseudopodia. The large figures are in good detail with 8 to 10 retral processes to the chamber and 12 chambers to a coil. The retral processes are in pairs. This is definitely a synonym of *Elphidium* Montfort, 1808.

Entrochus Ehrenberg, 1841 (Abh. Akad. Wiss. Berlin, 1841: 408). The genoholotype is *E. septatus* Ehrenberg (*l. c.*, p. 426). The type specimen was examined. It is from Recent material off Veracruz and is evidently a small *Cassidulina* and should be placed as a synonym under that genus.

Megathyra Ehrenberg, 1841 (Abh. Akad. Wiss. Berlin, 1841: 409). Ehrenberg named two species, *M. dilatata* and *M. planularia*. The type specimens of these were examined. Both are from Recent material off Veracruz. The first species is very difficult to make out as to its full characters, but the second is very definite and indicates that the genus should be placed as a synonym of *Planularia* Defrance, 1824.

Porospira Ehrenberg, 1844 (Ber. preuss. Akad. Wiss. Berlin, 1844: 75). Two species were named by Ehrenberg in 1844, *P. princeps* and *P. comes*. Both are from Oran and were later figured (Mikrogeologie, 1854: pl. 21, figs. 92, 93). In the book of drawings in the Ehrenberg collection the second species was later labeled "*Rotalia* Reuss, 1861" after the genus. A study of the type specimens shows them to be somewhat trochoid and probably representing a single species. They should be placed as synonyms under *Anomalina* d'Orbigny, 1826.

Spirobotrys Ehrenberg, 1844 (Ber. preuss. Akad. Wiss. Berlin, 1844: 247). The genoholotype is *S. aegaea* Ehrenberg (*l.c.*, p. 248), from the Aegean Sea. The type is very evidently, as was later marked in ink on the original drawing, "*Planorbulina mediterranea*." There are two excellent unpublished figures in the Ehrenberg collection and the genus is definitely a synonym of *Planorbulina* d'Orbigny, 1826.

Rhynchospira Ehrenberg, 1845 (Ber. preuss. Akad. Wiss. Berlin, 1845: 358). The genoholotype is *R. indica* Ehrenberg (*l.c.*, p. 376). The locality given is "Pulo Pinang." The type specimen definitely shows that it is a synonym of *Globigerina* d'Orbigny, 1826.

Clidostomum Ehrenberg, 1845 (Ber. preuss. Akad. Wiss. Berlin, 1845: 358). The genoholo-

[1] Received February 5, 1944.

type is *C. polystigma* Ehrenberg (*l.c.*, p. 368). The type specimen was examined. It is from Loandra, South Africa. The internal siphon is well shown and the genus should be placed as a synonym of *Bolivina* d'Orbigny, 1839.

Grammobotrys Ehrenberg, 1845 (Ber. preuss. Akad. Wiss. Berlin, 1845: 368). The genoholotype is *G. africana* Ehrenberg from Loandra, South Africa. The types were examined and the genus should be placed as a synonym of *Virgulina* d'Orbigny, 1826.

Spiropleurites Ehrenberg, 1854 (Ber. preuss. Akad. Wiss. Berlin, 1854: 248). Of the two species named, only *S. nebulosus* Ehrenberg was figured (Mikrogeologie, 1854: pl. 35, pt. B, iv, fig. 7). The specimen from the Atlantic may possibly be a young form of *Globorotalia menardii* (d'Orbigny) although Sherborn's Index refers it to "*Pulvinulina repanda*," which is an *Eponides*. Its position must therefore remain doubtful.

Pleurites Ehrenberg, 1854. There are several species figured under this genus in 1854, the first of which is *P. cretae* Ehrenberg (Mikrogeologie, 1854: pl. 27, fig. 32). It is from the Cretaceous of Meudon, near Paris. Ehrenberg had written later under the original figure "*Globigerina cretacea*," but it is not this. A study of the type specimen shows it to have a smooth surface with the aperture and triserial arrangement of the chambers of *Bulimina*. It should therefore be placed as a synonym of *Bulimina* d'Orbigny, 1826.

Synspira Ehrenberg, 1854. The genoholotype, *S. triquetra* Ehrenberg, was figured (Mikrogeologie, 1854: pl. 29, fig. 47) from the Island of Moën. The single specimen at first appearance seems to be allied to *Nubecularia*, but it is apparently perforate and perhaps allied to *Spirillina*. From this single specimen the genus must remain doubtful.

Ceratospirulina Ehrenberg, 1858 (Monatsb. preuss. Akad. Wiss. Berlin, 1858: 11). The genoholotype is *C. sprattii* Ehrenberg (*l.c.*, p. 19). The type specimen is from 500 fathoms, in the Mediterranean between Malta and Crete. The species was originally called *mediterranea* in Ehrenberg's notes but later was crossed out and *sprattii* added above. On the original notes it was called *Ceratoloculina*. The later record as *Ceratospyris sprattii* (Abh. Akad. Wiss. Berlin, 1872 (1873): pl. 11, fig. 7) is the same. The early portion is definitely 5-chambered, and the generic names should be placed as synonyms of *Articulina* d'Orbigny, 1826.

Encorycium Ehrenberg, 1858 (Monatsb. preuss. Akad. Wiss. Berlin, 1858: 11, 19). The genoholotype is *E. nodosaria* Ehrenberg (*l.c.* p. 19) afterward figured by Ehrenberg (Abh. Akad. Wiss. Berlin, 1872 (1873): pl. 11, fig. 13). The specimen is well figured but evidently incomplete. Each chamber has a short internal neck, and the test as examined is clear, thin, and smooth. On the sheet of original drawings there are numerous notes later referring it to various genera, *Nodosaria*, *Frondicularia*, and *Glandulina*. From the evidence of the specimen it may questionably be referred to *Ellipsonodosaria* A. Silvestri, 1900, as a synonym.

Selenostomum Ehrenberg, 1858 (Monatsb. preuss. Akad. Wiss. Berlin, 1858: 12). Two species were named by Ehrenberg, *S. aegaeum* and *S. fimbriatum*. Both are Recent forms from the Aegean Sea. A study of the type specimens showed that the genus is a synonym of *Cassidulina* d'Orbigny, 1826.

Dexiopora Ehrenberg, 1858 (Monatsb. preuss. Akad. Wiss. Berlin, 1858: 309). The specimen figured as *D. triarchaea* Ehrenberg (*l.c.*, pp. 309, 337, pl. 1, fig. 10) is marked "untersilurischer Grünsand, Petersburg." Parker and Jones noted that it might be a *Globigerina*, but from an examination of the specimen it seems more like a concretionary form and so far as could be made out is without structure and the name should be allowed to lapse.

Spirocerium Ehrenberg, 1858 (Monatsb. preuss. Akad. Wiss. Berlin, 1858: 310). The genoholotype is *S. priscum* Ehrenberg (*l.c.*, pp. 310, 337, pl. 1, fig. 14). An examination of the type specimen shows it to be a globular mass of glauconite with no definite structure, and the name should be allowed to lapse.

Aspidodexia Ehrenberg, 1872 (Monatsb. preuss. Akad. Wiss. Berlin, 1872: 280). The genoholotype, *A. lineolata* Ehrenberg, was figured (Abh. Akad. Wiss. Berlin, 1872 (1873): pl. 3, fig. 4) from Recent Atlantic material. The original specimen was not found in the Ehrenberg collection, but the original figure was seen and the name had later been changed to *Aspidospira*. The latter is a synonym of *Anomalina* d'Orbigny, 1826. *Aspidodexia* is probably a synonym of *Globigerina* d'Orbigny, 1826.

MAMMALOGY.—*The type locality of* Tadarida mexicana *Saussure.*[1] SETH B. BENSON, Museum of Vertebrate Zoology, University of California. (Communicated by HERBERT FRIEDMANN.)

In checking a list of type localities of Mexican mammals I encountered an apparent error in designating the type locality of the Mexican free-tailed bat (*Tadarida mexicana*). Shamel (Proc. U. S. Nat. Mus. **78**(art. 19): 5. 1931) gave the type locality as Ameca, Jalisco, Mexico, and stated: "The describer selects no specimen as type, but gives as the habitat the plateau of Mexico. Specimens are mentioned from Ameca, Jalisco, and from Cofre de Perote, Vera Cruz. In the United States National Museum collection are three specimens from San Pedro, Jalisco, which is in the immediate vicinity of Ameca, and 23 others from various places in Jalisco. I have therefore chosen Ameca, Jalisco, as the type locality. A specimen labeled, 'Mexico' (Saussure) and marked type of *Mollossus mexicanus* was examined in the Berlin Museum in 1904 by Mr. Miller who thinks it is probably a cotype."

This is not the first recorded designation of Ameca, Jalisco, as the type locality of this bat. The first known to me is by Miller (U. S. Nat. Mus. Bull. **79**: 70. 1912), who gave no comment as to the reason. This ascription has been commonly followed in the literature. Also, there is an even earlier designation of the type locality. Elliot (Field Columbian Mus. Publ., zool. ser., **4**: 629. 1904) gave the type locality as "Cofre de Perote, state of Vera Cruz, Mexico, 13,000 feet elevation," but gave no explanation.

Saussure's original description (Rev. et Mag. Zool., ser. 2, **12**: 283–285. July, 1860) contains the following statement (p. 285) concerning distribution: "Habite le plateau du Mexique et les hautes montagnes. J'en ai tué un individu sur le Coffre de Perote, à 13,000 pieds d'altitude; d'autres individus ont été pris à Ameca, au pied du Popocatepetl, à un altitude de 8,500 pieds."

There is no mention of Jalisco in this statement, and the only way to infer that Ameca, Jalisco, is the locality intended is to assume that the phrases "au pied du Popocatepetl, à un altitude de 8,500 pieds" refer to a third locality. Actually, the punctuation indicates that only two localities are intended and that the phrases referred to merely describe the location of Ameca more exactly. Ameca really means Amecameca, a town situated on the western base of Popocatepetl at the approximate elevation given by Saussure. Perhaps an error in transcription is involved, easy to make with a word like Amecameca, or perhaps Saussure used the abbreviated form that is sometimes used by the present inhabitants of Amecameca and that appears on some maps. A further indication that Amecameca is the locality in question is furnished in Saussure's description of *Molossus aztecus* (*op. cit.*) where he gave its distribution (p. 286) as follows: "Habite le plateau du Mexique. Tué à Amecameca, au pied du Popocatepetl."

The localities recorded by Saussure are therefore Cofre de Perote, 13,000 feet, state of Veracruz, and Amecameca, 8,500 feet, state of Mexico. Because Saussure definitely stated that he collected a specimen on the Cofre de Perote himself, giving this locality first, and because Elliot first definitely fixed it as the type locality, Cofre de Perote, 13,000 feet, state of Veracruz, Mexico, should be considered the type locality of *Tadarida mexicana*. If it can be definitely established in the future that the specimen whose measurements are given by Saussure came from "Ameca," then Amecameca, state of Mexico, might be considered as the type locality, but there is no valid reason for ascribing the type locality to the state of Jalisco.

[1] Received January 31, 1944.

PROCEEDINGS OF THE ACADEMY AND AFFILIATED SOCIETIES

PHILOSOPHICAL SOCIETY

1204th Meeting

The 1204th meeting was held in the Cosmos Club Auditorium, Saturday, October 10, 1942, President Brombacher presiding.

The President announced that the Joseph Henry lecture could not be given, as the lecturer had received orders from the Navy Department calling him out of town. He acknowledged the Society's indebtedness to Mr. Chrisler for volunteering to speak on very short notice.

Program: V. L. Chrisler, National Bureau of Standards: *Field measurements of air-raid warning devices.*—Total war has created the necessity of warning the civilian population of impending air attacks. As acoustic signaling has proved to be an effective method of warning, the Office of Civilian Defense asked the National Bureau of Standards to make a study of various devices available for this purpose. Most of the measurements have been made in a large open space with the device mounted 20 feet above ground. Frequency analyses of the signals were made at a distance of 100 feet from each device and the intensity levels measured at distances of 100, 700, 1,400, and 2,800 feet. Varying atmospheric conditions, such as wind, temperature, and humidity, had considerable effect upon the attenuation of sound with distance; in fact, for the devices tested, the effect of atmospheric conditions is more important than the distribution of energy in the different frequency components. (*Author's abstract.*)

This illustrated paper was discussed by Messrs. W. G. Brombacher, A. G. McNish, W. J. Humphreys, P. S. Roller, H. M. O'Bryan, C. E. Bennett, H. L. Curtis, F. J. Bates, and P. A. Smith.

1205th Meeting

The 1205th meeting was held in the Cosmos Club Auditorium, Saturday, October 24, 1942, President Brombacher presiding.

Program: Albert May, Catholic University of America: *The latent image in the photographic plate.*—The present theories of the latent photographic image were discussed, including the work of Gurney and Mott and the attempts to explain the solarization region. This was followed by a description of original research.

Experiments in hypersensitization of X-ray emulsions with mercury vapor showed that no appreciable increase of speed of these emulsions was obtained for X-ray exposures, nor for films hypersensitized after exposure to visible light. The results were shown to be consistent with existing theories.

Blackening curves of exposures extended into the solarization region showed broader first maximum peaks for visible light than for X-ray exposures. Calculated curves based on a simple model give a satisfactory agreement with the X-ray curve, and an average of about 60 X-ray quanta is found necessary to produce solarization in a photographic grain. (*Author's abstract.*)

This paper was discussed by Messrs. W. J. Humphreys, W. G. Brombacher, L. B. Tuckerman, and F. L. Mohler.

1206th Meeting

The 1206th meeting was held in the Cosmos Club Auditorium, Saturday, November 7, 1942, President Brombacher presiding.

Program: Frederick Seitz, University of Pennsylvania: *The photoelasticity of crystals.*—Experimental investigations of the mechanism of plastic flow in crystals show that blocks of the material become displaced relative to one another along definite crystallographic planes. This mechanism is commonly known as *slip*. The linear dimensions of the blocks that play a role in the process of slip are of the order of 1 micron. Straightforward estimates of the shearing stresses that would be required to produce a slip in an ideal crystal lead to values of the order of magnitude of 10^{11} dynes per cm^2, whereas the values actually observed in well annealed single crystals of pure metals and salts are of the order of 10^7 dynes per cm^2. As a result of this fact it is necessary to assume that crystal imperfections play a very important role in determining the actual mechanism of flow. The present viewpoint of the nature of the lattice imperfections that have bearing on the problem was discussed. It was pointed out that a particular type of imperfection known as a *dislocation* would explain both the actual mechanism of slip and the observed values of the

shearing stress. There is evidence to show that a few dislocations are always present in well-annealed crystals; however, it is necessary to assume that many more are generated during plastic flow. The change in number of these alters the properties of the material in many respects. There is also evidence to show that fissures and cracks which play an important role in reducing the rupture strength of crystals aid in the generation of dislocations. (Author's *abstract.*)

This paper was discussed by Messrs. W. G. Brombacher, L. B. Tuckerman, K. F. Herzfeld, A. Blake, and W. J. Humphreys.

In an informal communication Mr. L. B. Tuckerman presented an illustration showing that it is not necessary for the derivative of a function to be zero at the maximum or minimum values. It was discussed by Messrs. A. Blake and W. J. Humphreys.

1207th Meeting

The 1207th meeting was a joint meeting with the Washington Academy of Sciences. It is reported in this Journal **33**: 32. 1943.

1208th Meeting

The 1208th meeting was held in the Cosmos Club Auditorium, Saturday, November 21, 1942, President Brombacher presiding.

Program: D. R. Inglis, Johns Hopkins University: *The moments of atomic nuclei.*—Like the earth, the atomic nucleus has in many cases an angular momentum and a magnetic moment. The electric quadrupole moment of several nuclei indicates an elongation of form somewhat analogous to the flattening of the earth. The magnetic moments are measured by means of the hyperfine structure of atomic spectra arising from different orientations of the nucleus in the magnetic field of the atomic electrons, and more accurately by inducing transitions of orientation at resonance of a radio frequency and a frequency of Larmor precession. The observed magnetic moments of odd proton nuclei with a given angular momentum tend to be divided into two groups as though to correspond to the two orientations of the odd proton spin relative to its orbital angular momentum. This must depend on a tendency of spin to pair off as far as possible. This and the distribution of quadrupole moments in the periodic table may in part be a consequence of a partial grouping of protons and neutrons into alpha particles in the nuclei. (*Author's abstract.*)

This paper was discussed by Messrs. W. G. Brombacher, P. A. Smith, F. L. Mohler, and F. C. Brickwedde.

1209th Meeting

The 1209th meeting was held in the Cosmos Club Auditorium, Saturday, December 5, 1942, President Brombacher presiding. The minutes of the 71st annual meeting were read and approved.

The Treasurer's report was read by the Treasurer, Mr. W. Ramberg. The income from dues and investments during the past year was $1,215.16, and the expenditures were $1,014.55, leaving a surplus of $200.61. The average expenditure per member was $3.50. During the year the sum of $2,000 from the Trust account was invested in U. S. Saving Bonds.

The report of the Auditing Committee, A. Blake, R. P. Teele, and E. H. Vestine, was presented by the chairman, Mr. Blake. It was discussed by Messrs. W. J. Humphreys and H. F. Stimson. It was moved, seconded, and carried that the reports of the Auditing Committee and Treasurer be accepted as read.

The joint report of the Secretaries was presented by the Recording Secretary, Mr. F. L. Mohler. There were 15 regular meetings during the year, with an average attendance of 55. At these meetings 16 papers were presented. The membership losses were 12, and there were 16 new members, giving 319 active members on December 1, 1942. There were 36 on the absent list. It was moved, seconded, and carried that the report be accepted as read.

The report of the Committee on Elections, F. Wenner, A. K. Ludy, and J. S. Burlew, was presented by the Chairman, Mr. Wenner. He reported that those elected had received a majority of the votes with respect to the other candidates for the same office. It was discussed by Messrs. A. Blake and W. J. Humphreys. It was moved, seconded, and carried that the report be accepted, and the President declared the following officers duly elected:

President: R. J. Seeger
Vice Presidents: H. F. Stimson, F. L. Mohler
Recording Secretary: Archie Blake
Treasurer: Walter Ramberg
Members-at-large of the General Committee: K. L. Sherman, W. A. Wildhack.

The President opened the meeting for discussion of Society policies and recommendations to the General Committee. He remarked on the difficulty of securing papers and requested that members submit papers.

The Secretary read a rough draft of the minutes, and it was approved as read.

A paper on *Stellar explosions* was presented by Mr. George Gamow, of George Washington University. It was discussed by Messrs. A. J. Shneider, A. Blake, and W. A. Wildhack.

The President requested Past Presidents Brickwedde and McComb to escort President Seeger to the platform.

President Seeger introduced the newly elected officers to the Society and thanked the retiring officers for their services.

1210th Meeting

The 1210th meeting was held in the Cosmos Club Auditorium, Saturday, December 19, 1942, President Seeger presiding.

The twelfth Joseph Henry lecture, *The scientific significance of ferromagnetism*, was delivered by Dr. Francis Bitter. It was published in this Journal **33**: 235–238. 1943.

1211th Meeting

The 1211th meeting was held in the Cosmos Club Auditorium, Saturday, January 16, 1943, President Seeger presiding.

The retiring President's address, *Altitude by measurement of air pressure*, was delivered by Dr. William George Brombacher. (This paper will appear in this Journal.)

The address was followed by some remarks concerning recent data on the same subject by Prof. Philip Kissam, of Princeton University.

1212th Meeting

The 1212th meeting was held in the Cosmos Club Auditorium, Saturday, January 30, 1943, President Seeger presiding.

An invited paper, *Spectra of simple molecules*, was presented by Mr. G. H. Dieke, of Johns Hopkins University. It was discussed by Messrs. F. G. Brickwedde and A. Blake.

An informal communication on a graphical solution of certain problems in rate of work was made by Mr. W. Edwards Deming. It was discussed by Mr. A. Blake.

The President announced the resignation of Mr. K. L. Sherman from the Committee on Communications and the appointment of Mr. A. G. McNish to fill the vacancy.

1213th Meeting

The 1213th meeting was held in the Cosmos Club Auditorium, Saturday, February 13, 1943, President Seeger presiding.

Program: Elizabeth Rona, Trinity College: *Radioactivity of the ocean.*—It has been shown[1] that the ocean sediments, especially those lying below very deep water and far from the continent, have radium content 4 to 10 times greater than that of rocks, even of granite. In order to learn whether the origin of this high radium content can be explained by a chemical or biological precipitation from sea water, samples from different locations and different depths were investigated by H. Pettersson and the author,[2] and C. S. Piggott and Wm. D. Urry and the author.[3] In both sets of samples the amount of radium was found to be very low, in disagreement with the results found by former scientists, but in good agreement with R. D. Evans and collaborators.[4] The uranium content in the waters around the west coast of Sweden and in the northern Atlantic was found higher, as is necessary to uphold the equilibrium for radium found in the same samples, whereas in the sea bottom sediments the relation radium to uranium was just the opposite.

No possible explanation can be offered yet, until further investigations have been made. (*Author's abstract.*)

This paper was discussed by Mr. K. F. Herzfeld.

An informal communication on a queer but friendly function was presented by Mr. A. Blake. It was discussed by Messrs. A. G. McNish and L. B. Tuckerman.

1214th Meeting

The 1214th meeting was held in the Cosmos Club Auditorium, Saturday, February 27, 1943, President Seeger presiding.

Program: Dr. Richard C. Tolman, National Defense Research Committee: *Physical science and philosophy.*—This paper presented certain philosophical reflections as to the nature of

[1] Piggot, C. S., and Urry, Wm. D. Amer. Journ. Sci. **239**: 91. 1941.

[2] Göteborg's Kungl. Vet. Vitt.-Samhallas **6**(12). 1939.

[3] Not yet published.

[4] Amer. Journ. Sci. **36**: 241. 1938.

science, with illustrations drawn particularly from physics. The relative scopes of science and philosophy were first defined. In accordance with the limited scope of science, it was pointed out that the methods and results of science may all be characterized as objective and abstract. The objective and abstract characters of science were then discussed.

The test of objectivity was taken as that of common agreement and acceptance. Difficulties in applying this test were mentioned and two factors that help to control these difficulties were noted. Justification was presented for the circumstance that philosophy must make use of methods and results that are not objective. It was emphasized that the limitation of science to methods and results that are objective does not limit the fields of human interest to which scientific studies may be profitably applied.

The abstract character of science was taken, in the first place, as arising from the necessity of abstracting out that which is objective from the general consideration that men give to their experience. This led to a discussion of the relation between the subjective origins and objective outcome of scientific work.

The abstract character of science was taken, in the second place, as arising from the circumstance that each particular science abstracts a particular kind of phenomena for consideration. This led to a discussion of the Comte principle for the organization of the sciences into a hierarchy in accordance with the different levels of abstraction which they employ. With the help of this principle, the relations between different sciences were discussed. This discussion was illustrated by the relations of physics and chemistry—statistical mechanics and thermodynamics—kinematics, dynamics, and electrodynamics—physics and biology—and physics and psychology. The view was expressed that phenomena at one level of abstraction can not be completely treated at a deeper level of abstraction. (*Author's abstract.*)

This paper was discussed by Messrs. T. DANTZIG, P. S. ROLLER, A. G. MCNISH, H. E. MCCOMB, W. P. WHITE, H. C. DICKINSON, K. F. HERZFELD, and R. J. SEEGER.

1215TH MEETING

The 1215th meeting was held in the Cosmos Club Auditorium, Saturday, March 13, 1943, President SEEGER presiding.

Program: FREDERICK D. ROSSINI, National Bureau of Standards: *Modern thermochemistry.*—There was described the work of the National Bureau of Standards in thermochemistry, including a description of the method and apparatus, presentation of some of the experimental results, and application of the data in calculating chemical equilibria among hydrocarbons. The following topics were covered: The substitution method for comparing electrical energy with chemical energy, apparatus for reactions in a flame at constant pressure, apparatus for reactions in a bomb at constant volume, determination of the purity and amount of reaction, heats of formation and of isomerization of the paraffin and olefin hydrocarbons, and free energies of formation and equilibria of isomerization of the paraffin hydrocarbons. Some practical applications were briefly mentioned. (*Author's abstract.*)

This paper was discussed by Mressrs. H. L. CURTIS, L. B. TUCKERMAN, A. BLAKE, H. C. DICKINSON, and W. J. HUMPHREYS.

L. B. TUCKERMAN, National Bureau of Standards: *Early use of meteoric iron in weapons* (informal communication).—A paper in Poggendorff Annalen **26**: 350–352, 1832, *Account of an aerolith which fell some time ago in the Orient*, reported by the Chief Librarian of the Leipzig Royal Library, Prof. Dr. WILKEN was cited.

The Persian manuscript from which the following accounts are taken is to be found in the Leipzig Royal Library (Ms. Orient in 8vo No. 97). It was written in the sixth year of the reign of the Indian Padischah Mohammedschah (1723 A.D.). It has no title but contains the history of the Indian kings up to the time of the Padischah Mohammed Ewrengzeb, that is, up to the beginning of the eighteenth century.

It is preceded by an introduction in the manner of an encyclopedia in which many facts of physics, in particular meteorological appearances such as hail, rain, and snow, are discussed. In the discussion of storms the following accounts are given:

"It was reported by the Sheik Erreis, that a piece of iron weighing 150 men[5] fell one day in the neighborhood of Dschordschan, and the inhabitants of the region heard a remarkable

[5] The weight of the men is very differently reported, so much so that the values range between 40 pounds and 2 pounds.

noise. The parts of the piece of iron were arranged in the manner of grains of millet.[6] The piece of iron was brought to the Mayor of Georgia, whereupon the Sultan Mohammed of Gasnevide (reigned from 999 to 1030 A.D.) requested a part of it, which was brought to him. The Sultan commanded that a sword should be made of it, which however was not found possible."

"It is reported that in the sixteenth year of the reign of Padischah Dschehangir (1621 A.D.) a very loud noise from the East was heard one morning in the neighborhood of Dschalinder (a northern district of India) and at the same time a bright light like lightning was seen to fall down and vanish. Mohammed Said, the Mayor of this region, ordered that the place where it fell should be dug up. A piece of hot iron was found, which was brought under seal to the court and the Padischah Dschehangir ordered Master Smith David to make him a sword and dagger from it. The smith, however, stated that this iron would not hold together under the hammer, but could only be forged if it was mixed with another iron. Accordingly, such a mixture was made. Three parts of the lightning iron and one part of another iron were mixed together. From the mixture two swords, a dagger, and a knife were made, which, in cutting and wounding, were equal to the finest swords. Their design was excellent, although they bore no resemblance to the design of our swords." (*Author's abstract.*)

1216th Meeting

The 1216th meeting was held in the Cosmos Club Auditorium, Saturday, March 27, 1943, Vice-President Stimson presiding.

Program: Paul R. Heyl, National Bureau of Standards (retired): *The genealogical tree of modern science.*—Published in this Journal **33**: 327–334. 1943.

[6] I am not sure whether the word "gawirs" appearing in the Persian text is rightly translated by millet. The Sultan Von Aude in his book on the "Seven Seas" makes the following statement concerning this word (which was lacking in previous Persian dictionaries): "*Gawirs* is used to mean *millet*, but according to others it means *grain*, God knows." In the latest edition of Richardson's Persian dictionary the word is explained as meaning a kind of vetch. In any case the comparison with "gawirs" appears to be used to represent the kernellike appearance of the meteor stone.

This paper was discussed by Messrs. Shneider, F. L. Mohler, A. G. McNish, and Knapp.

An informal communication on the invention of the magnetic compass in Europe was made by Mr. P. R. Heyl.

1217th Meeting

The 1217th meeting was held in the Cosmos Club Auditorium, Saturday, April 10, 1943, President Seeger presiding.

Program: Rev. Paul A. McNally, S.J., Georgetown University: *The universe in which we dwell.*—The purpose of this lecture was to give a popular survey of the growth of man's knowledge in the field of astronomy, using as a unifying element the notion of distance.

Starting with a universe—Egocentric, since man was concerned, then, for the most part with himself and his immediate surroundings—whose limits were, probably, thought to be only a few hundreds of miles distant, the steps of man's progress in this field of knowledge may well be described under the captions or epochs —Geocentric, Heliocentric, Astracentric, Nebulacentric. During these epochs the size of the known universe grew—from the time when the boundaries of the universe were thought to be only a few thousands of miles away, until the present, when we know that the most distant objects in the skies—so far revealed by our largest telescopes—are hundreds of millions of light years distant.

Since the present year marks the four-hundredth anniversary of the death of Copernicus, special emphasis was given to the size and shape of the known universe of 1543 and the consequent revolution of thought occasioned by the introduction of the heliocentric theory.

A summary of the most recent scientific speculations on the nature of the "red shift" found in the spectra of the most distant objects in the sky was introduced to bring out the element of uncertainty in our present knowledge of the size of the known universe. (*Author's abstract.*)

This paper was discussed by Messrs. A. Blake, K. F. Herzfeld, A. G. McNish, and C. L. Garner.

1218th Meeting

The 1218th meeting was held in the Cosmos Club Auditorium, Saturday, April 24, 1943, President Seeger presiding.

Program: G. Rupert Gause, War Department: *Statistical control of quality in manufacturing and inspection.*—Variations in the quality of any material produced by mass production processes are of two types: natural variations inherent in the production process itself, and extraneous variations not inherent in the process itself, but for which assignable causes exist. Statistical quality control distinguishes between these two types of variations, and indicates when and where extraneous variations occur so that their cause can be eliminated. The control chart is a device for making this distinction in a routine fashion. It is a graphic record of inspection results, with limit lines to indicate when corrective action should be taken on the production process.

Consumer acceptance inspections exert a strong influence on the quality level which a manufacturer maintains, and they must be sound if proper levels are to be enforced. Since no one sampling procedure will accept every lot of satisfactory quality and reject every lot of unsatisfactory quality, inspection results obtained on successive lots must be summarized to obtain a precise measure of overall quality. If this quality is unsatisfactory, very strict acceptance procedures must be used; if consistently satisfactory, the amount of inspection can be reduced and major attention focused on unsatisfactory sources. (*Author's abstract.*)

This paper was discussed by Messrs. Tuttle, M. Goldberg, F. B. Silsbee, Bellison, Paul Norton, Carlton, T. C. Lyons, and Horace Norton.

1219th Meeting

The 1219th meeting was held in the Cosmos Club Auditorium, Saturday, May 8, 1943, President Seeger presiding.

Program: Richard Courant, New York University: *Stability and instability as demonstrated by soap films.*—Mathematical and physical methods often supplement each other in a manner whereby each throws light on the other's problems. This fact is well illustrated in the problem of Plateau, the problem of passing a surface of minimal area through a given closed space curve.

Interesting results on this problem, derived at length by the methods of the calculus of variations, may be illustrated by means of soap films made by dipping wires in the prescribed forms into a solution of soap and glycerine. The soap film assumes the shape of minimal potential energy, which is the same as the shape of minimal area, and accordingly solves the problem of Plateau.

The wires may be distorted or otherwise moved in such a way as to cause the soap film to pass from a configuration which is stable for one shape of wire to a topologically different configuration stable for another shape. (*Secretary's abstract.*)

This paper was discussed by Mr. A. G. McNish.

The meeting was adjourned early (9:35 p.m.) for the social hour to enable the members to experiment with the soap solution and wire apparatus, which the speaker had brought to demonstrate the manner in which soap films solve the problem of Plateau.

1220th Meeting

The 1220th meeting was held in the Cosmos Club Auditorium, Saturday, May 22, 1943, President Seeger presiding.

Program: J. J. Hopfield, National Bureau of Standards: *The Raman effect in chemical compounds.*—If a molecule has a permanent dipole moment, it will absorb infrared light, and the frequencies of vibration of the molecule are the frequencies of the absorbed light.

Raman spectra, on the other hand, are observed in the light scattered by molecules. This process of scattering is very inefficient so that weak lines are generally obtained. In this process of scattering the electric vector of the incident light *induces* a dipole moment in the molecule, and the *frequency differences* between the incident light and the Raman scattered light are the frequencies characteristic of the molecule. A strong spectrum of a few lines (Hg) and a fast spectrograph are necessary for easily observing these Raman spectra.

Since Raman spectra are characteristic of the observed molecules, their ions, or valence groups, one can use them as tools for identifying compounds, for quantitative analysis, for detecting the presence of various types of ions, for identifying various types of bonds or link-

ages, for the isotope effect, and in connection with the theory of molecular structure.

A unique use of Raman spectra is in the study of materials in aqueous solution in a low frequency range corresponding to one in the infrared in which water is too opaque for use. (*Author's abstract.*)

This paper was discussed by Messrs F. G. Brickwedde, F. L. Mohler, A. Blake, and Manov.

Mr. L. B. Tuckerman presented three informal communications, on Dr. Raman, on dishonesty in advertising, and on Professor Persy's formula.

Archie Blake, *Recording Secretary.*

Obituaries

Nathan Sanford Osborne, principal physicist at the National Bureau of Standards, died at his home in Washington, D. C., on September 18, 1943, after a long illness. Born at Southampton, N. Y., on February 10, 1875, he attended the public schools in Southampton and the Michigan College of Mines, where he received the degree of mining engineer and membership in Tau Beta Pi in 1899. The next few years were spent partly in the practice of mining engineering and partly as instructor in mathematics and physics at the Michigan College of Mines. His real bent, however, was for precise physical measurements, and his opportunity came when he joined the staff of the National Bureau of Standards in 1903. He served, until his death, as a member of the staff of the Bureau for a total of 38 years, continuously except for a period from 1910 to 1912, during which he was an instructor at the Michigan College of Mines.

He was married in 1910 to Lura M. Krebs, and is survived by her, by a daughter, Mrs. Douglas Robertson, and a son, Robert.

His first major scientific investigation was of the density and thermal expansion of ethyl alcohol and its mixtures with water. The tables based on the data obtained are still the standard of the United States Treasury and other departments of the Federal Government and are widely used in industry.

He returned to the Bureau in 1912 to participate in and later to take the leading part in the determination of the physical constants of interest to the refrigerating industry. After a series of determinations of the specific heat and heat of fusion of ice, the work on properties of ammonia was begun. This investigation covered the entire range of temperature and pressure likely to be useful in refrigeration and included determination of the properties of saturated liquid and saturated and superheated vapor. The work was extensive enough to provide a basis for complete tables of the thermodynamic properties of ammonia, published in 1923. These tables were accepted both here and abroad as authoritative and are still considered so by the engineering profession.

The work on ammonia served as a model for later investigations, and its completion doubtless was influential in leading the steam power industries to initiate a similar program on the properties of water and steam. The ammonia program had, however, consisted of a series of separate investigations which were brought together and correlated after completion. Osborne was not satisfied with this rather unsystematic procedure, and before beginning the researches on water and steam he worked out a much more systematic method of dealing with the problem, published under the title *Calorimetry of a fluid.* In this paper he outlined and described a procedure for determining the principal thermodynamic properties of a liquid and its vapor, using a suitably designed calorimeter for a series of correlated measurements. This method was the basis for the later work on properties of steam. He also planned an extension of the method to include some of the properties of the superheated vapor, but this part of the method has not yet been used.

Although educated as an engineer, Dr. Osborne attained eminence in the engineering world, not through the practice of his profession but by contributing for its use some of the fundamental physical data which are the foundation of engineering. His work has received wide recognition, as in the International Steam Tables, a large part of which is based on his work. He was a delegate to the three International Conferences on the Properties of Steam, held in England, Germany, and the United States in 1929, 1930, and 1934, respectively, and contributed much to their success. He was hon-

ored with the degree of doctor of science by Stevens Institute of Technology and the degree of doctor of engineering by the Michigan College of Mines. He was a member of the Philosophical Society of Washington and of the Washington Academy of Sciences.

It is fortunate that Dr. Osborne's work was done at a time when the equipment for measurements of temperature and pressure, and other factors required, had been perfected to such an extent that in combination with his own developments in calorimetry the accuracy attainable and actually attained was ample for engineering purposes, and adequate for present-day scientific requirements. It seems possible that the results of his work will be considered as definitive, and there is at present no prospect that the work will need to be repeated for many years to come.

In the design and construction of the apparatus required for his work, Dr. Osborne was reluctant to follow conventional practice until he had convinced himself that it was better than any new and original methods that he could devise. He became a skilled instrument maker and himself constructed some of the more delicate and difficult parts of his apparatus and produced some examples that could bear comparison with the product of the most skilled mechanics. He was always ready to give the benefit of his ideas and experience to anyone who asked for it, and in this way he made many valuable contributions to the work of others.

E. F. MUELLER.

EDWARD BENNETT MATHEWS, emeritus professor of mineralogy and petrography at Johns Hopkins University, died on February 4, 1944.

Dr. Mathews was born in Portland, Maine, on August 16, 1869. He received the bachelor's degree at Colby College in 1891 and was awarded the honorary doctor of science degree in 1928 as one of its most distinguished alumni. He received his training in mineralogy and petrography at Johns Hopkins University under Dr. George Huntington Williams. He was awarded the degree of doctor of philosophy in 1894 and was then appointed instructor in mineralogy and petrography upon the untimely death of his eminent teacher. From 1891 to 1894 he was a field assistant on the United States Geological Survey. In 1904 Dr. Mathews was promoted to the professorship in mineralogy and petrography and in 1917, upon the death of William Bullock Clark, succeeded him as chairman of the Department of Geology, which position he held until his retirement from active university duties at the age of 70 in 1939.

Soon after the Maryland Geological Survey was established in 1896, Dr. Mathews became assistant state geologist and in 1917 succeeded William Bullock Clark as state geologist, a position he held until compelled to retire on account of ill health in 1943. He was an important contributor to most of the volumes published by that Survey from his *Bibliography and cartography of Maryland* in volume 1, published in 1897, to the *Gazetteer of Maryland*, published as volume 14 in 1941. His contributions covered such fields as the petrography and structure of the piedmont, the building and ornamental stones, the limestones, the coals, the clays, the surface and ground waters, the mineral industries, and the physical features. Interest in history, bibliography, and cartography is reflected in such works as the *Bibliography and cartography of Maryland*, the *Catalog of published bibliographies in geology*, *The counties of Maryland and their origin*, *Maps and map makers of Maryland*, the report on the *Resurvey of the Mason and Dixon Line*, the report on the *Location of the boundary line along the Potomac River between Maryland and Virginia.* It was these same interests that impelled him throughout the years of his teaching to accumulate analyses of igneous rocks from all over the world, which culminated in the last years of his career as a Geological Society of America project under which he completed a search of geologic literature to assemble all extant igneous-rock analyses and arrange them geographically by latitude and longitude.

Dr. Mathews also served his adopted State in many other capacities, the range of which likewise testifies to the diversity of his knowledge and interests. He was director of the Maryland Weather Service from 1917 to 1933, executive officer of the State Board of Forestry from 1917 to 1925, member of the Maryland Development Commission, and member of the Water Resources Commission from its establishment in 1933 until it was merged in 1941 with the Maryland Geological Survey into the

Department of Geology, Mines, and Water Resources of which he became director.

Outside of Maryland, he served as chairman of the Division of Geology and Geography of the National Research Council from 1922 to 1925, as chairman of the Advisory Council of the United States Board of Surveys and Maps, as vice president and treasurer of the Sixteenth International Geological Congress, and as treasurer, member of the finance committee, and councillor of the Geological Society of America from 1917 until his death.

The diversity of his interests made him a great traveler and student of the classical geologic areas of Europe and other parts of the world, experiences that greatly enriched his knowledge of geologic history, places, and persons. This store of knowledge and experience he was ever ready to share with friends, colleagues, and students, who found him an unending and never-failing source of information.

The impelling motives that led Dr. Mathews into this wide range of activities were an innate intellectual curiosity and an unselfish desire to be of service and usefulness to others, and never an urge to display unusual wisdom or to bring himself into the limelight. He adroitly avoided public and formal exhibition of the versatility and range of his knowledge and experience but was always ready and willing to share them unobtrusively and informally in friendly conversation.

JOSEPH T. SINGEWALD, JR.

EDWARD OSCAR ULRICH, geologist and paleontologist, died on February 22, 1944, at the age of 87. He was born in Cincinnati, Ohio, on February 1, 1857, of parents who had come to the United States from Alsace in 1840. His father had been a soldier in the French Army, serving at one time as the commandant of a fortress in Algeria. His early education was received in the public schools of Cincinnati and of Covington, Ky. He later attended German Wallace and Baldwin Colleges, at Berea, Ohio, receiving the A.M. degree in 1886 and the Ph.D. degree in 1892. In deference to his father's wishes, he attended Pulte and Ohio Medical Colleges from 1876 to 1878, but did not complete the work for a medical degree.

Dr. Ulrich's early career was rather varied. He worked at his father's trade of carpenter and as a rodman for the waterworks department of Cincinnati, receiving his first impetus toward geology in connection with excavations for a city reservoir. In 1877 he became curator for the Cincinnati Society of Natural History. From 1880 to 1883 he was superintendent of the Little Caribou Silver Mines in Boulder County, Colo. For some years he worked intermittently as draughtsman, lithographer, and carpenter to provide a livelihood while he carried out his paleontologic investigations. From 1885 to 1889 and from 1891 to 1897 he was paleontologist for the Geological Surveys of Illinois, Minnesota, and Ohio; in 1890 and 1891 he was assistant geologist for the Kentucky Geological Survey. He joined the U. S. Geological Survey in 1897, remaining with it until his retirement in 1932. In 1914 he became an Associate of the U. S. National Museum and continued to hold that place until his death. He had been a member of the Washington Academy of Sciences since 1903.

Dr. Ulrich was an original fellow of the Geological Society of America, and had served as president of the Paleontological Society and the Geological Society of Washington. He was a member of the National Academy of Sciences and a corresponding member of the Geological Society of London and the Geological Society of Stockholm. He received in 1930 the Mary Clark Thompson medal of the National Academy and in 1932 the Penrose medal of the Geological Society of America.

He pioneered in many paleontologic fields. He was one of the first students of the stony Bryozoa, and his work there is fundamental. He was one of the earlier students of the conodonts, and his work on Paleozoic ostracods led to a classification that has been widely adopted. He participated in the preparation of numerous areal and stratigraphic reports and at times took a hand in purely economic papers, such as those dealing with copper deposits in Missouri and lead, zinc, and fluorspar deposits in Kentucky. He proposed radical changes in parts of the generally accepted stratigraphic classification, particularly in a major work entitled *Revision of the Paleozoic systems*.

Dr. Ulrich married Albertine Zuest in Cincinnati in 1886 and in 1933 in London Lydia Sennhauser, who survives him. There were no children.

JOHN B. REESIDE, JR.

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JOURNAL
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VOLUME 34 JUNE 15, 1944 No. 6

MEDICINE.—*Aspects of epidemiology of tuberculosis.*[1] LELAND W. PARR, The George Washington University.

Despite the difficulty the American Public Health Association had a short time ago in settling upon a definition of an epidemiologist, I believe it is not impossible to say what epidemiology is. Epidemiology is the ecology of disease. It is the life history and environmental relationships of disease. It places less emphasis on how disease acts on the individual and more on its mass manifestations; little on symptoms, much on how it spreads and is influenced by all possible variant factors.

The study of tuberculosis is tremendously complex, and the results that have been obtained are confusing. This is not because the organism causing the disease is difficult to obtain and study. True *Mycobacterium tuberculosis* grows slowly, but we have long had satisfactory culture mediums and suitable experimental animals are readily available. There is, however, no disease concerning which there are more disputed concepts and theories. Shortly after the tubercle bacillus invades the body successfully the tissues take on a new and specific capacity to react. If into the skin of such a person a tiny bit of the soluble protein of the tubercle bacillus is injected, there is a decisive response. The area becomes inflamed, slightly raised, unusually firm, and somewhat painful. It is, in fact, a typical area of response in inflammation. This reaction reaches its height on the second and third day and thereafter slowly fades away. This is a positive tuberculin test. By contrast, a person who has not been successfully invaded by the tubercle bacillus will give no reaction to a similar injection or indeed to one many times stronger in its tuberculin content.

The condition of the individual that causes him to react to the injection of tuberculin is the "tuberculin type of hypersensitivity." It would seem simple to determine whether it is better to be tuberculin positive or tuberculin negative, but it is not. Is this tuberculin type of hypersensitivity the same thing as immunity? It is not easy to decide, and any answer given will be disputed. Woodruff and Kelly (1942) observed: "Before tuberculosis can be controlled successfully fundamental concepts concerning reactions of the host to the infectious agent must be clarified. Perhaps the most important of these concepts is the relation between the hypersensitive or allergic response and immunity." Shall we immunize our children against tuberculosis? We immunize them against diphtheria; why not against tuberculosis? In 1940, 60,428 persons died of tuberculosis in the United States and only 1,457 of diphtheria. It may be objected that tuberculosis is not a childhood disease. It is not, and it is much less so now than it was in 1900, but in 1940 a total of 2,787 children under 15 years of age died of tuberculosis, almost twice the total number dying of diphtheria.

When we have clinical tuberculosis where do we get it? Is it from within—the lighting up of an old arrested focus—or is it from without by contact, often repeated, with open cases of tuberculosis? We now favor the latter view, exogenous infection, but it has not been many years since the former view, endogenous infection, was our gospel. Years ago we used to speak of the childhood type of tuberculosis. Now we call

[1] Address of the Retiring President of the Washington Academy of Sciences delivered at the 324th meeting of the Academy on February 17, 1944. Received March 15, 1944.

it "first infection phase." In this form of infection the tubercle bacillus localizes in the outer parenchyma of the lower- or mid-lung field, and there is developed an area which, when it later becomes encapsulated, calcified, or perhaps even ossified, is known as a Ghon tubercle. Before this happens, however, the little colony of tubercle bacilli, often too small to be seen with the naked eye, establishes connection with functionally adjacent lymph nodes and there sets up a focus of tuberculous infection that in time usually becomes calcified and, if large enough, visible in X-ray plates. The tubercle and its involved lymph node form the Complex of Ranke. As a usual thing an individual harboring this pathology suffers, particularly if he is not a very young or a weakly person, few if any clinical symptoms. Some years ago it was believed that almost every child had such a "primary infection." Now it is known that most children escape any form of tuberculous infection and that "first infection phase" tuberculosis comes in both adults and children. Is it the same usually benign disease in adults that it used to be in children, or is it much more serious? We have a debatable proposition.

Years ago we used to speak also of the "adult" form of tuberculosis. Now we call it "reinfection phase" tuberculosis. This is tuberculosis developing in an individual who has had "first infection phase" tuberculosis and is thereby a different host from the individual never contacted successfully by the tubercle bacillus. In this form of disease the lesion usually appears in the upper third of the lung and does not involve the functionally connected lymph nodes. When such lesions heal they show less of calcification and more of resorption and fibrosis. Spread of this type of disease, which frequently occurs, is by caseation, liquefaction, and excavation. This "adult" type of disease can, of course, occur in a child provided it is an individual who has had "first infection phase" tuberculosis. It was formerly thought that such disease arose chiefly from one's own reservoir of tubercle bacilli held over from an arrested "first infection phase" attack. The fact that overwork, worry, undernourishment, and other untoward socio-economic factors predispose to tuberculosis fitted in very well with the idea that each man carried about his own potential tuberculosis and might light it up as an adult by lowering his personal resistance.

The following quotation from the American Review of Tuberculosis (1920) is not the point of view held today:

> In adults the problem of preventing infection requires very little attention. The great majority of adults have already been infected before reaching adult life. What adults have to fear most is not further infection from without, but an extension of the infection which they already have, leading to the development of a group of symptoms which we are pleased to call the disease tuberculosis. All adults should of course avoid prolonged and intimate contact with the grossly careless tuberculous person; but there is little to be feared through ordinary contact. It has been said that the careful consumptive is not a danger to anyone. This might be modified to read the consumptive is a grave menace to infants, less dangerous to children, and no danger at all to adults if reasonable care be exercised.
>
> Let me emphasize again. We should not be afraid of the tubercle bacillus. For ourselves, as adults, as a rule we need fear no attack except from those that are now in our bodies. For the children, since we cannot permanently protect them from invasion, let us wisely choose the time when the bacilli are first to be met. If this be done, the tubercle bacilli may be transformed from a menacing enemy into a protecting friend. This is what should be taught to every adult, as comprising the knowledge in accordance with which he should live and act as an individual.

Today we favor the view that tuberculosis may be contracted from continued contact with open cases and that its incidence may be reduced by eliminating sources of infection from milk or meat; by minimizing contact with open cases through early and accurate diagnosis and isolation; and by proper care of those having tuberculosis including full attention to proper nutrition and conditions of living. What a change of point of view within a generation! Some areas are even working on the hypothesis that all tuberculosis can be prevented. Certainly one can not develop tuberculosis without first becoming tuberculin positive. Hence, in certain parts of the country where conditions are favorable an effort is being made to place tuberculosis on the county accreditation basis. In 1940 the death rate

for tuberculosis in the continental United States was 45.9 per 100,000, one of the finest rates anywhere in the world. It is a reasonable estimate that in that year about 50 percent of our total population were tuberculin positive. Minnesota has established county accreditation for tuberculosis. This "new idea in human tuberculosis control" provides that a county shall be accredited in which there is an average annual death rate of 10 or less per 100,000 and a tuberculosis infection rate, as evidenced by a positive tuberculin test, of less than 15 percent among high-school seniors. At least seven of Minnesota's 97 counties have already qualified for this honor.

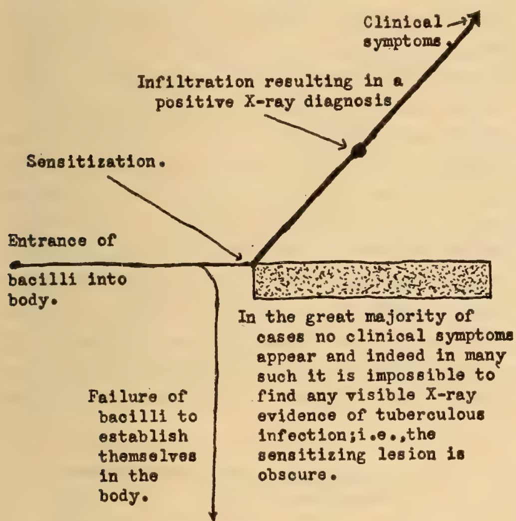

DIAGRAM I.—The result of the invasion of the body by tubercle bacilli.

Casual reference to tuberculous infection as something quite time extensive has probably been confusing to the reader. Reference to Diagram I should assist in the understanding of the early stages in the host-parasite relationship of the tubercle bacillus and man.

Some diseases are short lived and decisive. The patient is sick two or three days and then is about his work. Such a disease is a mild attack of influenza. In typhoid fever, on the other hand, the patient may be ill six weeks or more, and there is a further period of convalescence to add to the six weeks' loss of time from work. In tuberculosis there may be a very gradual onset involving two or three years before the patient has any symptoms at all. Probably every person in the United States has swallowed or inhaled at least one living tubercle bacillus even in this day of allegedly fine progress in the elimination of tuberculosis. In half, or more than half of us, the microbe did not successfully invade the body. (Some of the points involved in the host-parasite relationship bearing on this point are fascinating to contemplate but difficult to set in order, and they are graphically suggested in Diagram II.)

Shortly (two to seven weeks) after the tubercle bacillus has invaded the body the tissues become sensitized and the host is altered profoundly, just how profoundly we do not yet know. The elicitation of a positive tuberculin test from such a person is only one aspect of the matter. The sensitized individual possesses a new reaction pattern, which he will keep as long as viable tubercle bacilli remain in his body.

Fortunately, the great majority of sensitized individuals do not progress further toward clinical tuberculosis. Such individuals are harmless to others in their environment, for the tubercle bacilli causing the sensitization are locked within their bodies. Indeed, as Long has so well pointed out, the tuberculous individual does not enter into the epidemiological picture until his pathology is well advanced. Large lesions caseate, liquefy, and erode into bronchi where bacilli are spread farther within the lung of the hapless patient or expectorated to the outside world. Interestingly enough, the number of tubercle bacilli becomes very great in an area of just this type, whereas they might have been rather few in the same area a month earlier.

Only a few of those who become tuberculin positive for the first time will progress to the point where roentgenological evidence can be obtained that they are ill, and of these by no means all will advance farther to the point where clinical symptoms can be noted. Furthermore, if taken at the stage of minimal tuberculosis, the disease is easy to arrest. Even if arrested the individual will still, for a long time, likely for life, harbor some of the tubercle bacilli that

multiplied within his body. It may seem odd that one can be in good health and play host to pathogenic organisms. Such a healthy arrested case should not be a source of danger to others, but it is important to point out that every extensive survey of adults reveals some of these individuals who are not satisfactorily arrested cases and who continue to work or even attempt to enlist in the Army or Navy while really suffering from moderately advanced or even far advanced tuberculosis. Ironically, many of them are not even aware of the seriousness of their condition. The tubercle bacillus is not a vicious pathogen despite the fact that it causes the most important single disease from which man has ever suffered. It is therefore all the more important that the facts about tuberculosis be known, so that medical practice and science can continue adequately in the effort to solve the tuberculosis problem.

What is the present status of tuberculosis as a medical problem?

First of all, it is worthy of note that there has been a very marked decrease in this country in the number of deaths from tuberculosis. In 1900 the rate was 194.4 per 100,000; in 1940 it was 45.9; in 1942 it was 43.1. There was only 1 death in 1940 where there were 4.2 deaths in 1900. Not only has the number of deaths decreased but the distribution of those deaths has changed both within the total mortality picture and within the mosaic of tuberculosis itself. Table 1 will make some of these changes clear.

It will be noted that in 1900 tuberculosis accounted for 11.3 percent of all deaths. By 1940 this figure had fallen 2.6 times, to 4.2 percent. Another significant point not shown in the table is that the disease is becoming pulmonary in type. In 1940, of the 60,428 deaths from tuberculosis, 55,576 deaths were pulmonary tuberculosis. Just over 8 percent were tuberculosis of the central nervous system, gastrointestinal tract, the bony structures, the skin, the lymphatics, the genitourinary system, generalized tuberculosis, and infection of other organs. Forty years ago this figure would have been much higher. Other changes we may note are a great decrease in the proportion of deaths from tuberculosis in infancy, childhood, and adolescence, and even in early married life. There has been a relative increase in tuberculosis deaths in the middle and later years of life, and there is no longer for whites a peak in the curve representing deaths from tuberculosis. It is rather a plateau extending

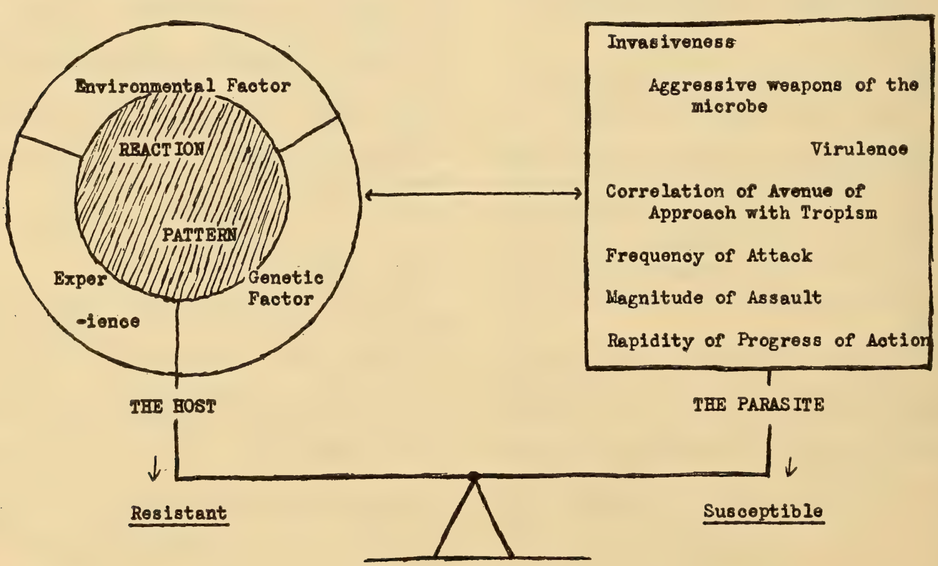

Diagram II.—Some of the factors entering into the host-parasite relationship which have much to do in determining the outcome of an infection.

over three or four of the most important decades of life.

Tuberculosis mortality is much higher among males than among females. In the States Relations Division of the United States Public Health Service there is now a Tuberculosis Control Section headed by Dr. H. E. Hilleboe. Tuberculosis mortality in the United States, 1939–1941, was reviewed by three Public Health Service workers in Public Health Reports for October 1, 1943. They point out that for these three years, 1939–1941, the male death rate (53.6) was 41 percent higher than the female rate (38.1). This excess in mortality among males is higher for tuberculosis than that from deaths from all causes. For these three years tuberculosis was seventh in numerical importance among the leading causes of death. There are very large racial differences in tuberculosis mortality, the rate for Negroes in 1940 (123.5) was nearly three and one-half times that for whites (36.6). The rate for Indians, Chinese, and other races was about double that for Negroes. Among non-whites tuberculosis was third in numerical importance as a leading cause of death. Another point, hotly disputed in the epidemiology of tuberculosis, is whether the Negro tuberculosis experience is the result of the less favorable socio-economic conditions under which they live or is due to inherent biological racial differences between whites and Negroes.

Tuberculosis is still among the three leading causes of death for a relatively large portion of the life span (15–49 years of age). It holds first place at ages 15 to 34, second at 35 to 39, and third at 40 to 49. For males tuberculosis is among the first three leading causes of death at ages 15 to 54, and for females at ages 10 to 44. For whites only, it is among the first three leading causes of death at ages 15 to 49 for both sexes, ages 20 to 54 for males, and 15 to 44 for females.

Table 1 reveals the fact that though we have made worthwhile progress in the fight against tuberculosis this progress compares unfavorably with advances made in the control of such diseases as typhoid and diphtheria, and indeed for the whole group listed together in the table, viz., typhoid, malaria, measles, scarlet fever, whooping cough, and diphtheria. In 1900 tuberculosis caused only 1.7 times as many deaths as this arbitrarily selected group. In 1940 this figure became 7.1 by virtue of the more perfect control of the selected group of diseases. Significant, too, is the more marked diminution in the deaths that occur in chil-

TABLE 1.—CHANGE IN DEATH RATES (PER 100,000) FROM 1900 TO 1940 FOR TUBERCULOSIS AND SOME OTHER DISEASES

Disease	Ratio 1900/1940	1900	1905	1910	1915	1920	1925	1930	1935	1940
All deaths	1.59	1,719.1	1,588.9	1,468.0	1,317.6	1,298.9	1,168.1	1,132.1	1,094.5	1,076.4
Tuberculosis	4.2	194.4	179.9	153.8	140.1	113.1	84.8	71.1	55.1	45.9
Percent of all	2.6	11.3	11.3	10.4	10.6	8.7	7.2	6.2	5.0	4.2
Typhoid	31.3	31.3	22.4	22.5	11.8	7.6	7.8	4.7	2.7	1.0
Malaria	5.6	6.2	2.5	1.1	1.6	3.4	2.0	2.9	3.5	1.1
Measles	26.6	13.3	7.4	12.4	5.2	8.8	2.3	3.2	3.1	0.5
Scarlet fever	19.2	9.6	6.8	11.4	3.6	4.6	2.7	1.9	2.1	0.5
Whooping cough	5.5	12.2	8.9	11.6	8.2	12.5	6.7	4.8	3.7	2.2
Diphtheria	36.6	40.3	23.5	21.1	15.2	15.3	7.8	4.9	3.1	1.1
Totals	17.6	112.9	71.5	80.1	45.6	52.2	29.3	22.4	18.2	6.4
Diarrhea in babies (−2)	15.2	115.9	98.4	98.4	55.7	43.4	30.8	19.4	10.4	7.6

Data from the Bureau of the Census, based on the expanding Registration Area. Since 1933 this area includes all continental United States.

The rate for tuberculosis was 4.2 times as high in 1900 as it was in 1940. This is for all ages. The change has not been the same for all age groups:

Under 1 year	12.6	25–34 years	5.2	65–74 years	3.1
1– 4 years	8.2	35–44 years	4.2	75–84 years	3.4
5–14 years	6.5	45–54 years	3.2	85 years and up	3.2
15–24 years	5.3	55–64 years	2.9		

dren under two years of age from diarrhea and enteritis. That improvement in the tuberculosis picture has occurred is, of course, true. Our chances of dying of tuberculosis are now computed at quite a more favorable level. It is also of interest to note that the percentage of persons tuberculin positive has been falling. For instance, one of the earliest reports on the results of tuberculin testing of a student group was based on a study conducted at the University of Minnesota in 1928. Thirty-one percent of 2,000 students were found to be tuberculin positive. In 1941–1942 only 17 percent of 5,481 students were positive. Thus in 13 years there was a reduction of 45 percent in the number of tuberculin reactors. Similar information gathered from school surveys all over the country is much more significant than may on first thought occur to one. We are fast becoming a nation of unsensitized individuals with respect to tuberculosis. There has long been a considerable school that has maintained that sensitization in the sense of tubercularization without progression is protection. What, they ask, will be the outcome as more and more tuberculin negative children become adults and first meet the tubercle bacillus under war-time and reconstruction conditions? It is possible that the medical-school tuberculosis problem may cast light upon this matter, but before that point can be presented it is logical to consider the effect of war on tuberculosis morbidity and mortality.

What was the effect on the tuberculosis rate of World War I? Dr. Long describes the situation in Europe by observing: "After years of continuous drop, the rate began rising in 1915 and by 1918 had reached a figure in all countries about 25 percent higher than at the beginning of the war." Wolff has described the privations of the period as "an involuntary mass experiment . . . of more epidemiological importance than endless theorizing on the pathology of tuberculosis." These statements may be amplified in the words of an August, 1941, article in the Statistical Bulletin of the Metropolitan Life Insurance Co., in part as follows:

The experience of the World War of 1914–1918 affords an indication of what is likely to occur. None of the belligerent countries escaped an increase in tuberculosis then, and practically all of the neutral countries of Europe suffered either an increase in tuberculosis or a slowing up of the prewar rate of decline. The most reliable data for the period relate to the trends among women and children in England and Germany. Among English women the mortality from pulmonary tuberculosis rose steadily during the war to a peak in 1918, when it was over 25 percent higher than in 1913. Among German women the pulmonary tuberculosis death rate rose slowly at first, but after 1916 the increase was very rapid, so that by 1918 the rate was nearly 75 percent above that of 1913. Indeed, in Germany the death rate from tuberculosis among women did not return to the prewar level until 1921; and this improvement was not maintained for a few years following. The rate of increase among German females was greatest at ages under 20 years. Among children the rate in 1919 was even higher than during the war.

Far worse was the situation among the other belligerent countries of the Continent, but only fragmentary statistical data are available to show the frightful increases in some of these areas. The statistics of tuberculosis mortality in France during the war are defective because of the absence of facts for the invaded regions, where the situation was at its worst. The data for the uninvaded portion show a sharp increase, particularly in 1917 and 1918. In the latter year the recorded rate was about 20 percent higher than in 1914. The accuracy of these statistics is doubtful, and the actual increase was probably larger. To some extent the same observation probably holds for Italy, but in that country even the recorded deaths from tuberculosis in 1918 were over 40 percent in excess of the 1914 rate.

A few examples will show the extremely bad conditions in Belgium and in eastern and southeastern Europe. In Brussels the death rate from tuberculosis doubled during the war, from 177 per 100,000 in 1914 to 390 in 1918. In Vienna the rate in the period 1915–1918 was 20 percent higher than in 1911–1914, and in the early postwar years it increased to 50 percent above the prewar rate. In Budapest the number of deaths from the disease in 1917 was nearly double that of 1913, and it was but little less in 1918. In Warsaw the rate in 1917 was 840 per 100,000, as compared with 306 in 1913; in Cracow during the same period the rate increased from 487 to 908 per 100,000. In Belgrade the tuberculosis death rate in 1918 reached the almost incredible figure of 1,400 per 100,000.

Typical of the trend of tuberculosis in the neutral countries of Europe during the World War are the experiences of the Netherlands and Switzerland. In the former, the death rate from the disease rose steadily, until in 1918 it was nearly 50 percent above the 1914 figure. In

Switzerland, where the trend was sharply downward before the war, the rate continued to fall at first, but rose in the latter part of the war to a peak of 207 per 100,000 in 1917, or 6 percent above the rate in 1914.

In our own country the mortality from tuberculosis showed little change during the World War period as a whole, but even here there was a slight increase in the death rate during the period of our active participation in the war. Thus the death rate in the original Registration States declined from 148.6 per 100,000 in 1914 to 143.8 in 1916, but then rose to 147.1 in 1917 and further to 151.0 in 1918."

These increases come about through breakdown in resistance to disease on the part of the host, to increase in opportunities for infection, and to a decrease in or, indeed, collapse of facilities available for proper recognition, isolation and treatment of disease. Specifically some of the factors for tuberculosis are:

1. The entrance of women into heavy and fatiguing industry.

2. The return of the older age groups to active employment.

3. The return to work of persons of either sex or any age physically unfit to work.

4. Long hours of work often emotionally compensated for by long hours of strenuous or injudicious relaxation—"burning the candle at both ends."

5. Relocation in areas of intense war industry activity resulting in congested living conditions without adequate sanitary facilities.

6. Relocation in areas of intense war industry activity where tuberculosis rates may be high by persons coming from areas where tuberculosis rates are low.

7. Congestion in concentration camps, war prisoners' camps, evacuation depots or camps, and air-raid shelters.

8. Use of hospital beds formerly allocated to the tuberculous for more urgent war needs or actual destruction of hospital facilities by the bombings or bombardments of "total" warfare.

9. Loss of trained personnel to the war need —physicians, nurses, attendants, laboratory workers, and social workers—all needed to care for an increasing load of tuberculosis patients.

10. Food shortages, both qualitative and quantitative.

11. Impossibility for perfect rest conditions so necessary for the tuberculous and the pretuberculous.

12. Worry and anxiety over the fate of one's relatives or even of one's country.

One of these points deserves particular emphasis as far as this country is concerned. As pointed out in an editorial in the New England Journal of Medicine for January 27, 1944, "it is estimated that 25,000 had been diagnosed (*at induction*) to have a disease that neither they nor their friends would have suspected under prewar conditions. And how are these patients, many of whom need sanatorium treatment, going to be accommodated by the currently restricted personnel of the sanatoriums?" Early in 1942 the number of beds for tuberculosis patients in this country totaled 97,726, or 1.62 per annual death, which is at best well below the minimum standard set at 2 beds per annual death and far below the more ideal standard of 3. In 1942 only seven states and the District of Columbia had met the minimum standard. It is quite possible that under present conditions of personnel shortage the paper figure of 97,726 beds available for tuberculosis patients must be considerably discounted. Where fighting is actually going on the condition is, of course, much worse.

Just what has happened thus far in the present war? Hilleboe states that by the last half of 1942 in the United States the Bureau of the Census, by a sampling process, had sensed an increase in tuberculosis in the "critical areas," although the total figure for 1942 represents an all-time low rate of 43.1 per 100,000. In England he notes a 13 percent increase in deaths from all forms of tuberculosis in 1941 as against 1938. This represents more than 3,000 additional deaths each year from a preventable disease. Recently in the British Medical Journal (January 8, 1944) it is stated that in Belgium the registered cases of tuberculosis increased from 69,079 in December, 1941, to 109,511 in February, 1943, an increase in rate from the high figure of 830 per 100,000 to the startling figure of 1,330 per 100,000. If there are 10 clinical cases of tuberculosis for every annual death

we have in the United States less than 600,000 cases at the present time or only six times as many as now exist in little Belgium, which has perhaps only one-twentieth of our population. Many of our people are in, or shortly will be in, these unfortunate European countries. It would seem a safe prophecy to venture that the tuberculosis rate in this country may be slightly increased for a short period, but it should within a very few years again resume its downward trend.

In view of the very low rate now obtaining (43.1 in 1942) it would be reasonable to expect a greater setback relatively than we experienced at the end of World War I. The magnitude of this setback may not be so much one of significantly increased rate as of slowness to get under way again on the downward trend. For a disease as widely seeded in our population as tuberculosis and for a population more completely involved in abnormal war activity than was the case in World War I, it would not be surprising if this were to be so and the very favorable rates now attained would seem to be advanced posts we may have to abandon for some time. One factor in this slightly pessimistic prediction is our closeness to and commerce with the rest of the world in many parts of which tuberculosis is rampant.

At one time the hope was expressed that we might be able to eradicate tuberculosis by a given date—say 1960. It should be understood that any such statement was merely a slogan, a cry behind which to rally the forces fighting the great white plague. As Frost ably pointed out in one of his last papers, entitled "How Much Control of Tuberculosis?" it "is not necessary that transmission be immediately and completely prevented. It is necessary only that the rate of transmission be held permanently below the level at which a given number of infection spreading (i.e., open) cases succeed in establishing an equivalent number to carry on the succession. If, in successive periods of time, the number of infectious hosts is continuously reduced, the end result of this diminishing ratio, if continued long enough, must be the extermination of the tubercle bacillus." I am not aware that Frost ever set any date for this millennium. As a very humble student of epidemiology I am sure I can not. I doubt though if under present war conditions we have any reason to anticipate any lowering of the death rate for the entire country from 43.1 to even 10 per 100,000 for several decades. Many millions of Americans are already tuberculin positive; thousands of unrecognized advanced cases of tuberculosis exist today; Europe and indeed most of the rest of the world is heavily tubercularized. It is too much to expect tuberculosis death rates to continue to drop as rapidly as they have in the past. To reduce 194.4 by 10 percent is not so difficult as to reduce 43.1 by 10 percent.

One other point that Frost makes deserves our attention. He states: "It is highly probable that the cyclic changes in prevalence which are observed in some diseases are brought about chiefly by evolutionary changes in the characteristics of the specific microorganisms, the causes of which are to be found in uncontrolled natural forces." Frost mentions scarlet fever and diphtheria as two of the diseases that within the past 100 years have greatly changed, although in the case of diphtheria the change reversed itself and diphtheria is again a problem of some significance in parts of the world. Smallpox, since the Spanish American War, has been relatively mild when it has occurred in this country and in 1942 caused but two deaths. It could be possible that cyclic changes may be taking place in the nature of the tubercle bacillus making it less invasive, but whether this is so, how long it will continue, or whether it will reverse are propositions very difficult of proof. Again, case-finding among medical students and physicians yields results with suggestive implications for this point.

Case-finding means looking for cases of a given disease. It is done to discover unrecognized cases that should be brought under treatment for their own good and isolated or educated so that the public health may be protected by removing active sources of infection. Although useful for several diseases such as malaria and hookworm, even syphilis, case-finding is particularly adapted to tuberculosis. It is possible through tuber-

culin testing to discover those belonging to the tuberculin positive group of persons who can have tuberculosis and, by X-ray examination, to detect which of these have physical signs almost certain before long to produce clinical symptoms. Such individuals may be satisfactorily arrested with a minimum of treatment and loss of time whereas if the minimal case is not discovered in its incipiency a moderately advanced or even a far advanced case may result which is difficult or impossible to arrest. The great advantage to the careful examination of the would-be soldier or sailor is that tuberculosis is discovered, as never before, in the stage in which it is possible to do something about the matter. From the first approximately 400,000 men appearing for the Canadian Army, 1 percent were rejected for tuberculosis. Of 3,530 of these rejectees, there were 1,970 minimal tuberculosis, 1,298 moderately advanced cases, and 262 far advanced cases. This ratio of the different clinical types (and the same is true for all other large scale screenings) is the exact reverse of what occurs when we let nature take its course. In the past, minimal cases have been a minority in the treatment program with moderately advanced and far advanced cases constituting the great majority of cases coming to the attention of the physician and the care of his sanatorium. It is to be hoped that although we are at war care will be taken that the young men and women found to have tuberculosis will be adequately cared for.

Tuberculin testing is time consuming and costly and, I regret to say, is sometimes omitted from the case-finding set up. Celluloid films, 14 by 17 inches, are also very expensive, and several substitutes have been worked out making it possible to examine the lungs of all members of a group (a good case-finding team can do 500 persons a day) at a reasonable cost. While this expedient works and is therefore justified, from the epidemiological point of view it is distinctly faulty because the tuberculin test gives information we must have for the proper understanding of the disease, and the large plate provides a permanent record unequaled by most of the less costly substitutes. At George Washington University Medical School, through the interest and cooperation of the dean, a proper and complete case-finding program has been in progress almost five years. The organization and operation of this program are graphically indicated in Diagram III.

It will be seen from Diagram III that five different agencies must be integrated in the program. These are the tuberculin-testing group, the X-ray group, the chest physician group, the laboratory group, and the sanatorium group. Coordination is best effected by that agency having most student contact, which in our institution is the tuberculin-testing agency represented by the writer. When there is sufficient interest in the program on the part of the coordinator the cooperation of the other agencies is easily obtained and cheerfully given. In addition to the value of such a program to the health of the student body the tuberculosis case-finding program is an admirable laboratory experiment in preventive medicine.

When it was realized that exposure to open cases of tuberculosis had to be considered as an important factor in the etiology of the disease it was only natural that thought turned to medical personnel—physicians, nurses, hospital attendants, and students of medicine and nursing—as persons having an industrial hazard with respect to tuberculosis. Three examples will illustrate the validity of this assumption. Diehl and Myers reported in 1940 that at Minnesota it had been possible to check effectively on the careers of 1,673 of 1,894 medical students graduating from 1919 to 1936. Among these there were 107 cases of tuberculosis, 5 occurring before college, and 47 after college. It was found that 46 deaths had occurred among the 1,673, of which 11 had been from tuberculosis.

Again it is well known that inmates of our mental hospitals form a group among whom tuberculosis is especially important. A recent study of such individuals in New York revealed that on the average tuberculosis deaths in such groups in this state were relatively 12 times more numerous than for the state as a whole. In certain such institutions in this country where careful case-finding programs have been carried out on the attendants rates of infection and actual evi-

dence of disease, much higher than occurs for other individuals in the same area have been found.

Thirdly, the early experience at the University of Pennsylvania revealed the significance in that institution of tuberculosis for medical students. Less than 10 years ago among 514 Pennsylvania students 5.8 percent of significant tuberculosis was found. Happily, results in most other schools are much better, and in fairness to Pennsylvania it should be pointed out that subsequent studies there have revealed a very much lower rate. Nevertheless, there seemed to be much logic to the statement made in 1930 by Stiedl of Trudeau when he said: "Tuberculosis might be called an industrial hazard for the medical profession. It is the most important chronic disabling disease for the medical student, the young physician and the nurse."

In 1939 a case-finding program at George Washington University School of Medicine was instituted. For many years prior to this, as I shall show presently, we had been making tuberculin surveys of all students, but a complete case-finding program had not, prior to 1939, been in existence in our institution. It is greatly to the credit of my former colleague, Dr. John H. Hanks, now in the Philippines, and Dr. David James, then president of the Junior Class, that they furnished much of the initial enthusiasm needed to get the program under way. The interest from the first of Dean Walter A. Bloedorn and the whole-hearted cooperation of the roentgenological and chest physician group insured the success of the project. We have already indicated in a diagram how tuberculosis case-finding works. It remains merely to give some of the results and to make a few observations.

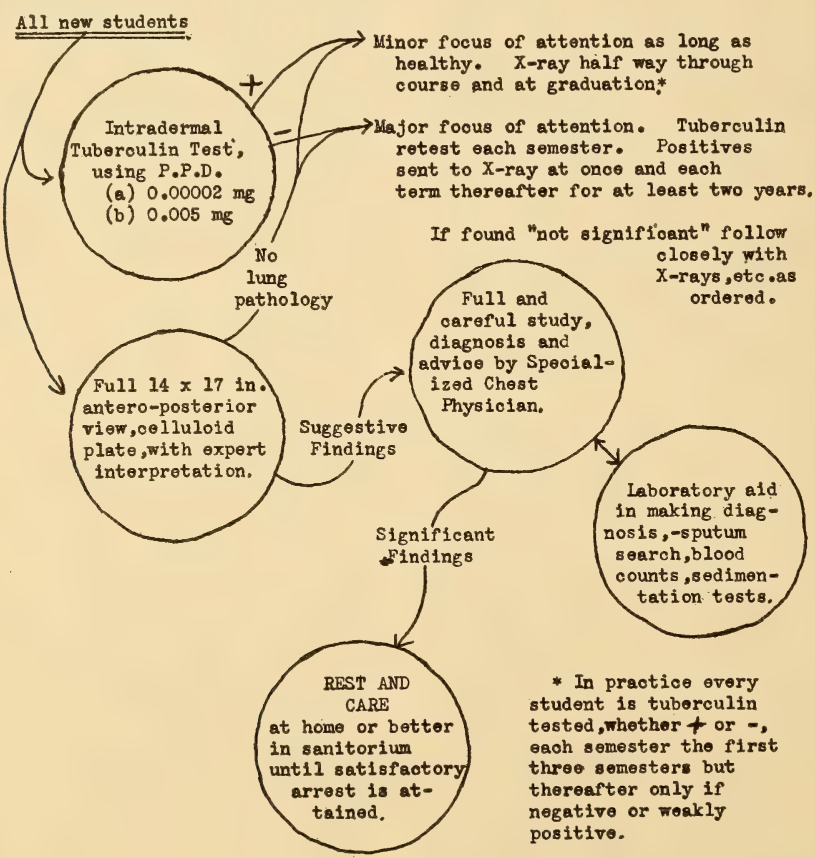

Diagram III.—Tuberculosis case-finding program at the School of Medicine, George Washington University.

The percentage of tuberculin positive reactors among fourteen consecutive classes totaling 1,007 students at George Washington University School of Medicine is shown in Table 2. With so many tuberculin negative students in school, a situation true in most other schools also, it was only natural to expect that many of them would become tuberculin positive. A good many of these tuberculin negative students did become tuberculin positive but not nearly so many of them as one might expect. Washington is in an area of high tuberculosis mortality (1940 figures, entire U.S.A., 45.9 per 100,000 population, District of Columbia, 64.4; Maryland 79.1; Virginia, 58.1), and our students certainly come into contact with tubercle bacilli. We were particularly impressed by the large number of those who were originally tuberculin negative and who remained negative through a complete medical education in Washington, D. C. Data on this point are presented in Table 3.

TABLE 2.—TUBERCULIN TESTS ON 14 CONSECUTIVE MEDICAL CLASSES AT THE GEORGE WASHINGTON UNIVERSITY

Class	Status	Number	Percent positive
1936	Sophomore	62	82.2
1936	Freshman	71	98.5
1937	Freshman	69	78.2
1938	Freshman	74	54.0
1939	Freshman	65	55.3
1940	Freshman	64	60.9
1941	Freshman	69	69.5
"1942"*	Freshman	71	42.2
"1943"	Freshman	74	44.6
"1944"	Freshman	65	46.1
"1945"	Freshman	78	34.6
"1946"	Freshman	77	40.2
"1947"	Freshman	83	53.0
"1948"	Freshman	85	43.5

* This school has been on the accelerated plan since before Pearl Harbor; the entering classes no longer require 4 years for graduation.

TABLE 3.—TRACING MEDICAL STUDENTS, ORIGINALLY TUBERCULIN NEGATIVE

Class	Total number of students tuberculin negative as Freshmen	Num- of these who left school	Number who completed all 4 years	Of these, number graduating tuberculin negative	Percent
Graduating Nov. 1943	35	5	30	22	73
Graduating Feb. 1943	42	6	36	21	58
Graduating 1942	40	3	37	23	62
Graduating 1941	21	5	16	7	44
Graduating 1940	24	6	18	13	72
Graduating 1939	30	6	24	11	46
Totals	192	31	161	97	60

Of the 64 students, originally tuberculin negative, who became tuberculin positive, *four* developed clinical tuberculosis—one man losing two years, one losing one year, and two no time loss. All four at present are in fine physical condition.

We were further impressed by the fact that a considerable number of medical students who gave weakly positive tuberculin tests later became negative. Students were not followed prior to 1939 through all semesters; hence the figures on this point do not include all our approximately 1,000 students. Of those followed (666), however, 134 have reacted only to the strong dose of Purified Protein Derivative. This represents a low grade of sensitivity due perhaps to an almost negligible original sensitizing lesion or to a lesion almost completely sterilized or possibly, in an occasional case, to a nonspecific reaction. Nine classes are included in this aspect of the study, four of which are still in school, on whom obviously the data are not yet complete. In the five classes concerned that have graduated 56 showed weakly positive reactions as Freshmen. Of these, 18 showed stronger reactions as they progressed through school, indicating some sort of sensitizing or immunizing process at work. Six became entirely negative and one became weaker in tuberculin reactivity, 22 remained the same, and a few of the original Freshmen did not graduate. Among the 666 students of these nine classes 319 were positive to some strength of tuberculin as Freshmen (47.9 percent). Of these, 134 (42.0 percent) were weak reactors. Among the 323 students of the last four classes there were 139 reacting to tuberculin (43.0 per cent), of whom 78 were only weakly positive (56.1 percent). Among the 343 students in this series who have graduated there were 180 tuberculin reactors (52.4

percent), but of these only 56 were weak reactors (31.1 percent).

Several points may be made regarding these data. An environment containing tubercle bacilli does not prevent a certain number of weakly positive tuberculin reactors from becoming negative. These individuals may be thought of as resistant strains of the human race. Our newer students are showing not only a lower total tubercularization rate but also a tubercularization of less intensity. Tubercle bacilli in the environment are doing less to medical students than formerly. This is susceptible to three interpretations. The tubercle bacilli in the environment are becoming fewer; they are losing invasiveness and virulence; or, thirdly, the resistance of the young white American to tuberculosis is increasing. The first point is obvious but can hardly be the whole explanation. I believe we miss the full significance of the data if we do not also allocate some importance to each of the other two explanations.

Weight is added to this suggestion when we consider that the total number of tuberculin negative students in the school, all presumably susceptible to successful invasion by the tubercle bacillus, is increasing. This number is the census made up each semester after the tests are done. In November, 1941, there were 147 tuberculin-negative students in the school. In June, 1942, this number was 157. In November, 1943, it was 166 among 313 students, or a student body only 46.9 percent tuberculin positive. There has been a slight increase in the total number of students in the school, but this has been balanced off by the fact that our last two classes, though the initial tuberculin positive rate was low, had higher percentages than the average of the preceding four classes (48.3 as against 41.3 percent). Furthermore, since this program was started in 1939, only nine students have been found with minimal tuberculosis, although three others were detected shortly following graduation. At the present time, with 313 students in attendance, not one has minimal tuberculosis. This fine record surpasses that revealed in almost any mass survey of adults. Among 28,098 U. S. Government employees recently surveyed, 1.1 percent had recognizable tuberculosis (60.7 percent minimal; 35.3 percent moderately advanced; 4.0 percent far advanced).

It has been our purpose in presenting these observations to emphasize that although remarkable progress has been made in combating tuberculosis that progress has not equaled advance achieved in controlling other well-known diseases. We must believe that tuberculosis is still a major problem. Its eradication may be set back by the war but not irrevocably. Tuberculosis morbidity and mortality can be reduced to a satisfactorily low level, but I do not expect to see in my lifetime the absolute elimination of the disease. Our evidence suggests that the tuberculosis problem is not at present unduly significant for medical students and that there is some ground for considering either that the young white adult has more resistance to the tubercle bacillus than his father possessed or that the *Mycobacterium tuberculosis* is losing some of its virulence. Possibly a little of both is true.

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ETHNOLOGY.—*Algonkian ethnohistory of the Carolina Sound.*[1] MAURICE A. MOOK, American University. (Communicated by WILLIAM N. FENTON.)

SOURCES

During the period of first white contacts the Indian tribes inhabiting the area of the present State of North Carolina were of three linguistic stocks—the Iroquoian, Siouan, and Algonkian. The first two groups have been made the objects of investigation by both historians and anthropologists, but the Algonkian have been neglected and are still commonly called, as for example by Kroeber, the "little known" inhabitants of the Carolina Sound. Even the names and identities of some of the tribes are still in doubt—a situation due partly to the lack of primary historical sources relating to the groups in question and partly to students' failure to exploit thoroughly such sources as are readily available. The sources are few enough, and they are not particularly rewarding ethnologically. It seems time, however, to attempt an ethnohistorical picture of the area such as we already have for the neighboring native areas of the state (1).[2]

The Algonkian-speaking tribes of eastern North Carolina represent the southernmost extension of the groups of this linguistic relation which inhabited the Eastern States. All the tribes of New England were Algonkian in speech, those of the eastern portions of the Middle Atlantic states were of the same linguistic family, and the inhabitants of the tidewater area from the Potomac to the Neuse River were similarly affiliated (2). The classification is entirely linguistic, rather than racial or cultural, and is the only one available in the light of present information. The English were not so interested in native peoples as were the French or even the Spanish, and the historic ethnology of areas of English colonization is proportionately inferior. However, scattered native words in the relations of the Roanoke adventurers, modern place names of Indian derivation in the area, and the short Pamlico vocabulary given by Lawson in his *History* (3) are sufficient to justify the classification of the eastern native Carolinians as indisputably Algonkian.

The delimitation of the area of aboriginal Algonkian occupancy in Carolina is complicated by the fact that it was not coterminous with natural geographical lines of division, as was the case in Virginia. The Algonkian tribes of the Powhatan Confederacy in Virginia inhabited the tidewater area, with the fall line of the tidal rivers marking the western limit of Algonkian tribal distribution. In Carolina, however, tribes of Iroquoian and of Siouan speech also occupied the coastal plain. These latter groups were the western and southern neighbors of the Algonkian, with the latter inhabiting the region east of a line drawn from Bogue Inlet due north to the intersection of Meherrin River and the Virginia–Carolina line. Algonkian peoples thus occupied the greater portion of the area now contained in the 17 easternmost counties of the State, including most of the offshore islands. Algonkian occupancy covered some 6,000 square miles, approximately one-sixth of the land area of the modern State. The limits of distribution are tentative, however, for the western Algonkian boundary is merely suggested by contemporary accounts.

Our knowledge of the Carolina Algonkian of the late sixteenth century is derived

[1] Received February 28, 1944.
[2] Numbers in parentheses refer to the "Notes" at the end of the paper.

entirely from the documents of Raleigh's Roanoke enterprise. Historical research has added little of ethnological significance to the relations published by Hakluyt in 1590. It is now possible, however, to interpret these with less ethnohistorical naïveté than was characteristic of the days of Hawks, Hale, and Tarbox (4). Also for the problem of reconstructing tribal geography at the time of contact students now have access to facsimiles of John White's original maps of the Carolina coast (5). Until the publication of these facsimiles it was generally assumed that the engravings published by De Bry were faithful reproductions of the John White drawings. The De Bry engravings however, are now shown to be embellishments of White's original maps and other ethnological pictures (6). It has been said that "De Bry's engravings were copied, plagiarized, redrawn and re-interpreted for generations after his time" and that "De Bry is the man who immortalized the pictures (and maps) of the Roanoke colony" (7). This is historically correct, but it is also true that De Bry himself "copied, redrew, and re-interpreted" and that his pictures "immortalized" elaborations of the John White originals, rather than the originals themselves. Students of history and ethnology will prefer the originals in accurate facsimile (8). These are particularly valuable, for they are the first pictorial record of Algonkian environment and culture in the New World. Other than by the use of archeological methods it is impossible to come nearer to the aboriginal situation of precontact times in this area than by study of White's drawings and the written records of 1585–1590.

The written materials of the Roanoke colony are exceedingly uneven as sources of aboriginal history. Hariot's *Report* (9) is usually considered the classic in this respect, but it is disappointing as a document for ethnological and historical reconstruction. Unfortunately, Hariot's "Chronicle, according to the course of times," which in his *Briefe Report* he stated he had written and was holding for a "convenient" time for publication, apparently never was printed, or, if it was, it is now among the missing documents of the history of Roanoke settlement. From the point of view of historical anthropology this is a particular misfortune, for Hariot tells us that the Chronicle was a "large discourse . . . of the naturall inhabitants" (10).

Whereas Hariot's *Report* is quite silent on matters of tribal identity, location, history, and intertribal relationships, its section on "the nature and maners of the people" is historical in the sense that it describes aspects of the native culture at the time of contact. It is a gross exaggeration, however, to speak of it as "a statistical survey on a large scale" (11). Both historically and ethnologically it is less informing than Barlow's *The first voyage made to the coasts of America* (12). The value of the Barlow relation, on the other hand, is somewhat reduced by the fact that the first voyage was one merely of preliminary exploration, by an expedition too small in size and too short in duration to make more than superficial surveys of a small portion of the coast. Relationships with the natives were friendly, and Barlow was successful in obtaining considerable information during the few weeks he was in the Algonkian area. His tract was a report to Raleigh that presented a more hopeful picture of colonizing prospects than the resources of the region deserved, but there is little to indicate that his descriptions of native life are characterized by mistakes other than those that were the natural result of misunderstanding due to hasty and untrained observation.

White's relations of the fourth and fifth voyages made to Roanoke in 1587 and 1590 (13) are journals of the voyages, rather than accounts of experiences in the Carolina area. As such they are of little value as sources for the study of native history. Their almost complete lack of ethnological consciousness is sufficient, in fact, to suggest that John White the governor and the author of the relations may have been a different person than John White the artist of Lane's colony and the author of the map of 1585 (14). The map, with its long list of native locations, and the drawings of Indian scenes and subjects reveal an awareness of the native inhabitants that seems entirely foreign to the relations of the last two voyages.


EARLY·ALGONKIAN
TRIBES·AND·TOWNS
LATER · HISTORIC · TRIBES
SHOWN · IN · PARENTHESES
CHOWANOC
(CHOWANOC)
WEAPEMEOC
(POTESKEET)
(PASPATANK)
(YEOPIM)
MORATOC
SECOTAN
(ROANOAK)
(MACHAPUNGO)
(HATTERAS)
POMOUIK
(PAMLICO)
(NEUSE)
NEUSIOK
Ramushonoq
Cautaking
Chawanok
Ohanoak
Maraton
Metackwem
Tandaquomuc
Moratoc
Mascoming
Weapemeoc
Chepanoc
Pasquenoc
Dasamonquepeuc
Roanoak
Mecopen
Tramaskecoc
Aquascogoc
Pomeioc
Cotan
Pananaioc
Secotan
Secotaoc
Croatan
Rouconk
Chatooka
Neusiok
MEHERRIN RIVER
NOTTOWAY
PASQUOTANK RIVER
CURRITUCK SOUND
North River
Perquimans River
Little River
ALBEMARLE SOUND
ROANOKE RIVER
Scuppernong River
Alligator R.
Pungo River
PAMLICO RIVER
PAMLICO SOUND
NEUSE RIVER
TRENT RIVER

The prime documentary sources for the ethnogeography and ethnohistory of the Roanoke experiment are White's map (15) and Ralph Lane's *Account of the particularities of the imployments of the English men left in Virginia by Sir Richard Greenevill* (16). In spite of the development of unfriendly relations between the natives and colonists under Lane's governorship, Lane's account shows him to have been an individual of ethnological discernment. His narrative is the only Roanoke relation of more than perfunctory value for the student interested in the location, distribution, and relationships of the Carolina Algonkians and their neighbors in 1585. De Bry seems to have sensed its importance in this respect as early as 1590, for although this publisher chose Hariot's *Report* in preference to Lane's *Account* for the first volume of his *Voyages* (17), his map is based upon White's with additions of some of the locations mentioned in Lane's account (18). Both maps are therefore useful for the study of the tribal geography and the native history of the period. New maps of Carolina did not appear until the latter part of the next century (19), by which time the Algonkian tribes were so reduced in both population and culture as to be deemed unworthy of recognition by contemporary cartographers. Lawson was the only writer of the period of permanent settlement who took generous cognizance of the existence of the native tribes of Carolina; his map, however, shows but three names of Indian derivation in the Algonkian area, and these were used as place names rather than as designations of tribal locations (20).

References to locations in the Roanoke relations show that the explorations made by Lane and his colonists apparently took them to most of the important tribal towns inhabited by the Algonkian groups of the Sound area at the time. Their discoveries were confined largely to the shores and islands of Pamlico and Albemarle Sounds, and to the coastal area bordering the bays and rivers adjacent to the larger bodies of water. A trip was made to the Chesapeake tribe situated at the southern end of Chesapeake Bay, and two voyages were made into the interior in explorations of the Chowan and Roanoke Rivers. One exploration was made southwestward from Roanoke, probably as far as the Neuse River, but contemporary knowledge of the region south of the lower Pamlico River seems uncertain and ill-defined. In a concluding passage of Hariot's *Report* it is stated that "al which I have before spoken of have bene discovered and experimented not farre from the Sea coast, where was our abode and most of our traveling; yet sometimes . . . we made our journeys further into the maine and Countrey" (21). Hariot elsewhere referred to discoveries 80, 120, and 150 miles from Roanoke (22). Lane was still more specific with respect to the distances and directions involved in the exploratory expeditions under his direction. In the ethnogeographically most explicit passage of the relations he described the explorations of the colonists as follows:

Our discoverie . . . of the Countrey . . . hath beene extended from the Iland of Roanoak, the same having bene the place of our settlement or inhabitation, into the South, into the North, into the Northwest, and into the West.

The uttermost place to the Southward of any discovery was Secotan, being by estimation fourescore miles distant from Roanoak. The passage from thence was through a broad sound within the mayne, the same being without kenning of lande, and yet full of flats and shoals. We had but one boate, which could not carry above fifteene men . . . Winter being at hand we thought good wholly to leave the discovery of those parts untill our stronger supply.

To the Northward our furthest discovery was to the Chesepians [Chesapeake], distant from Roanoke about 130 miles. The passage to it [Currituck Sound] was very shallow and most dangerous . . . The territorie and soyle of the Chespians, being distant fifteene miles from the shoare . . . is not to be excelled by any other whatsoever. There be sundry Kings, whom they call Weroances, and Countreys of great fertility adjoyning to the same, as the Mandoages, Tripanicks, and Opossians, which all came to visite the Colonie of the English, which I had for a time appointed to be resident there.

To the Northwest the farthest place of our discovery was to Chawanook, distant from Roanoak about 130 miles. Our passage thither lyeth through a broad sound [Albemarle], but all fresh water, and the chanell full of shoales. The Townes about the waters side situated by the way are these following: Passaguenoke The woman's Towne, Chepanoc, Weapomeiok, Muscamunge, & Metackwem, all these being under the jurisdiction of the king of Weapomiok, called Okisco.

From Muscamunge we enter into the River and

jurisdiction of Chawanook. There the River beginneth to straighten untill it come to Chawanook, and then groweth to be as narrow as the Thames betwene Westminster and Lambeth. Betwene Muscamunge and Chawanook upon the left hand as wee passe thither is a goodly high land, and there is a Towne which we called The blinde Towne, but the Savages called it Ohanoak, [which] hath a very goodly corne field belonging unto it. It is subject to Chawanook.

Chawanook it selfe is the greatest Province & Seigniorie lying upon that River, and the very Towne it selfe is able to put 700 fighting men into the fielde, besides the force of the Province it selfe . . .

Very neere [to the mouth of Chowan River] . . . directly from the West runneth a most notable River, and in all those parts most famous, called the River of Moratoc [Roanoke]. This River openeth into the broad Sound of Weapomeiok [Albemarle] . . . Moratoc it selfe . . . is a principall Towne upon that River . . . The Mangoaks . . . is another kinde of Savages dwelling more to the westward of said River (23).

Lane proceeds to describe his exploration of the Roanoke River to a point that took the party more than 160 miles from Roanoke Island. The exploration led them into the territory of the Mangoak, or Mandoag (24), the Carolina Algonkian term for their western Iroquoian neighbors (25). The foregoing passage is of special interest in its references to the locations and towns of the Weapemeoc, Secotan, and Moratoc tribes. These positions can be determined with greater exactness by reference to the data of contemporary cartography. For collateral textual evidence, however, it is necessary to consider passages from two other relations.

The voiage made by Sir Richard Greenvile for Sir Walter Ralegh, to Virginia, in the yeere 1585 (26) is in the form of a brief journal of the daily experiences of the English during the two months that Grenville was in the colony. Its references to native locations are as follows:

The 26 [of June] we came to anker at Wocokon . . . The 3 [of July] we sent word of our arriving at Wococon to Wingina at Roanoak . . . The 6 M. John Arundel was sent to the maine, and Manteo with him, and Captaine Aubry and Captaine Boniten the same day were sent to Croatan . . . The 8 Captaine Aubry and Captaine Boniten returned . . . To Wocokon. The 11 day the Generall [Grenville, with Lane, Hariot, Amadas, John White] . . . and divers other Gentlemen . . . passed over the water from Wocokon to the maine land . . . in which voyage we first discovered the townes of Pomejok, Aquascogoc, and Secotan, and also the great lake called by the Savages Paquipe, with divers others places . . . The 12 we came to the Towne of Pomeiok. The 13 we passed by water to Aquascogok. The 15 we came to Secotan, and were well entertained there of the Savages.

The 16 we returned thence, and one of our boates with the Admirall was sent to Aquascogok, to demaund a silver cup which one of the Savages had stollen from us, and not receiving it according to his promise, we burnt and spoyled their corne and Towne, all the people being fled (27). The 18 we returned from the discovery of Secotan, and the same day came aboord our Fleete ryding at Wococon. The 21 our Fleete ankering at Wococon, we wayed an anker for Hatoraske. The 27 our Fleete ankered at Hatorask, and there we rested. The 29 Grangino, brother to King Wingina, came aboord the Admirall, and Manteo with him. The 2 [of August] the Admiral was sent to Weapomeiok. The 5 M. John Arundell was sent for England. The 25 our Generall wayed anker and set saile for England (28).

The above locations occur on the maps of White and De Bry and can be transferred to modern maps with the aid of such supporting geographical information as can be found in the narratives of the colony. A passage from Barlow completes the roster of native place names as they occur on the early charts. Barlow's information is a supplement to that of the other relations, for it mentions two tribes, the Pomouik and Neusiok, that are not referred to by Hariot, Lane, or White. His facts, however, are from native informants rather than based upon his own discovery or exploration. His references are as follows:

My selfe with seven more went twentie mile into the River that runneth toward the Citie of Skicoak, which River they call Occam (29), and the evening following wee came to an Island, which they call Roanoak, distant from the harbour [inlet] by which we entred seven leagues. At the North end thereof was a village of nine houses, built of Cedar, and fortified round about with sharpe trees to keep out their enemies, and the entrance into it made like a turne pike very artificially (30). When wee came towardes it, standing neere unto the waters side, the wife of Granganimo, the kings brother, came running out to meete us very cheerefully and friendly. Her husband was not then in the village . . .

Beyond this Island there is the maine lande, and over against this Island falleth into this spacious water, the great river called Occam (31) by the inhabitants, on which standeth a toune called Pomeiock. And sixe dayes journey from the same is situate their greatest citie, called Skicoak,

which this people affirme to be very great; but the Savages were never at it, only they speake of it by the report of their fathers and other men, whom they have heard affirme it to bee one houres journey about.

Into this river falleth another great river, called Cipo, in which there is found great store of Muskles in which there are pearles. Likewise there descendeth into this Occam another river, called Nomopana [Chowan River], on the one side whereof standeth a great towne called Chawanook, and the Lord of that towne and countrey . . . is not subject to the kind of Wingandacoa (32), but is a free Lord . . .

Towards the Southwest foure dayes journey is situate a towne called Sequotan, which is the Southermost towne of Wingandacoa, neere unto which [is] . . . an out Island, unhabited, called Wocokon . . . Adjoyning to this countrey aforesaid called Secotan beginneth a countrey called Pomouik, belonging to another king whom they call Piamacum, and this king is in league with the next king adjoyning towards the setting of the Sunne, and the countrey Newsiok, situate upon a goodly river called Neus. These kings have mortall warre with Wingina, king of Wingandacoa but about two yeeres past there was a peace made betweene the King Piemacum and the Lord of Secotan, as these men which we have brought with us to England have given us to understand (33). But there remaineth a mortall malice in the Secotanes for many injuries and slaughters done upon them by this Piemacum . . .

Beyond this Island called Roanoak are maine Islands . . . with many townes and villages along the side of the continent, some bounding upon the Islands, and some stretching up further into the land (34).

Barlow's narrative is one of the most valuable minor histories of English colonization in the New World. Although its geography is largely based upon the reports of his native informants, supplemented by such explorations as could have been made in a few weeks by a small party in two barks, it is none the less valuable on that account. It offers the most direct and detailed information concerning the political organization and intertribal relationships of the coastal Algonkian groups that is available for this region. It is the first record of white contact with the natives of the Sound area, and it is, therefore, impossible to come nearer to the local precontact aboriginal culture by historical methods of investigation than by a study of its descriptions of the native way of life (35). Barlow's relation, though shorter than Hariot's *Report*, is more genuinely ethnological and is more valuable for its general cultural description than for its allusions to tribal geography. It is characterized by numerous naïvetés and contains some items of misinformation (36), but when it is remembered that the first voyage was made to a strange environment and that Barlow was at first without command of the Algonkian language, the information embodied in his account seems all the more remarkable. Lane's and Hariot's works are longer and for some aspects of ethnology more explicit; both of these writers, however, were in the Algonkian area approximately a year, and they had in Manteo a native informant who had been in England five to six months and must have acquired in that time a working knowledge of the English language.

LATE SIXTEENTH CENTURY TOWNS AND TRIBES

Apart from the above-quoted passages from Carolina's first historians, the data of the narratives respecting tribal names, locations, and relations are scattered and fragmentary. When collected, collated, and interpreted in the light of independently established historical and ethnological facts, it is possible to suggest the following with respect to the location of tribal territories, the towns within them, and the relationship of the tribes to each other in the area of Algonkian occupancy:

The Weapomeiok, or Weapemeoc (37), inhabited the area north of Albemarle Sound, including the four northeastern present counties and perhaps also the southern part of Chowan County. White's map specifies four native towns in this area as "Weapemeoc(an)"; while De Bry's map and succeeding ones designate the entire area north of Albemarle Sound and east of Chowan River as belonging to the same group. Their northern neighbors were the Chesapeake, a tribe on the south bank of the James River, which then inhabited the two southeasternmost counties of present Virginia; their western neighbors were the Chowanoc, who occupied both banks of the river which took their name. The Weapemeoc "king," or chief, in 1585 was Okisco, whose relations with the chieftains of neighboring groups reveal the native political

status of his own tribe. He was independent of Menatonan, chief of the Chowanoc, but was dominated to some extent by the latter, by whom he was induced to acknowledge subjection to the English. Lane states that Menatonon "commaunded Okisko, King of Weopomick, to yeelde himselfe servant and hommager to the great Weroanza (38) of England, and after her to Sir Walter Raleigh; to perfourme which commandement received from Menatonon the sayde Okisko . . . sent foure and twentie of his principallest men to Roanoak . . . to signifie that they were ready to perfourme the same, and so had sent there his men to let mee knowe that from that time forwarde hee and his successours were to acknowledge her Majestie their onely Soveraigne" (39).

Although subservient to the Chowanoc chief, Okisko conducted himself independently of Pemisapan, chief of the Secotan, in the latter's conspiracy against the colonists. Pemisapan, as chief of the natives of Roanoke Island and the adjacent mainland (40), had hoped for Okisko as an ally in his plans for an attack upon the English. "Okisko, king of Weopomeiok [was to] . . . be mooved, and with great quantitie of copper intertained, to the number of 7 or 8 hundred bowes, to enterprise the matter" of attack. Pemisapan dispatched messengers to Okisko, who were "with great imprest of copper in hand" and who made "large promises . . . of greater spoile." Okisko, however, sent word to Pemisapan that neither he nor "any of his especiall followers" would be "of the partie . . . and therefore did immediately retire himselfe with his force into the maine." But "Weopomeiok . . . was devided into two parts, [and] . . . the rest of the province accepted" Pemisapan's proposition and "received the imprest" (41).

The Weapemeoc are thus revealed as a tribe separate from and independent of their neighbors to the west and to the south, although Okisko's authority as a chief seems to have been somewhat weaker than that of his neighboring chieftains in their jurisdictions. The reference to the possibility of drawing upon 700 or 800 warriors from Weapemeoc territory suggests a total tribal population of at least 2,500 (42). Lane's figure of the number of warriors north of Albemarle Sound may be unduly exaggerated, as most contemporary estimates are (43); on the other hand, Mooney's calculation of a total population of 800 for the "Weapemeoc of 1585" would seem to be unreasonably conservative (44). Perhaps 500 warriors, with a total population of 1,500 to 1,750, would be a reasonable estimate.

Some of Okisko's "principallest men" were the chiefs of towns within the territory of what the English called his "kingdom." There are records of four towns within Weapemeoc tribal limits—Pasquenoc, Chepanoc, Weapemeoc, and Mascoming. Here, as usual, the chief tribal town was of the same name as the tribe. Lane's enumeration of them in the order above given may indicate that this was their relative location from east to west, for he mentioned them in this order in a context in which he described crossing Albemarle Sound in order to enter the Chowan River. His reference to them as "about the waters side" suggests that they were on the shore of the Sound, probably at or near the mouths of the northern rivers. The Eastern Algonkian were notable rivermen, and their villages were located, if possible, on the necks of land formed by converging streams (45). With these considerations in mind, and with the aid of White's and De Bry's maps, it is possible to suggest locations of the Weapemeoc settlements more specifically as follows:

On the De Bry map and its copies Pasquenoc, or the "Woman's Town," is placed on the second point of land west of Currituck Sound; this would be modern Camden Point, in southern Camden County, between the North and Pasquotank Rivers. It is entirely possible, as Mooney suggested, that Pasquotank as the name of the river and the modern county is a corruption of the name of this early native village (46). Lawson located a "Paspatank" Indian town, with ten warriors, in this vicinity in 1709 (47). Mooney's location of Pasquenoc "on the north shore of Albemarle sound perhaps in Camden county" (48) would place the town at Camden Point. Hawks claimed to "have no difficulty in fixing the

locality of Passaquenoke," but his location of it "in the southwest corner of the present county of Pasquotank" (49) places it too far to the west. It is impossible to use White's map for a specific location in this instance, for the map shows but one river flowing into Albemarle Sound from the north, and it is impossible to decide which river is intended. However, White's "Masequetuc" is undoubtedly synonymous with the Pasquenoc of other sources. Gerard's derivation of the latter term from *pasakwenok*, meaning "close together people," is an attempted etymology with a meaning appropriate enough for any native town or village. Speck's analysis of *pa-skwen-ok* as "woman's town or village" is more in accord with Lane's information; on the same basis White's term *ma-skwe-tuk* would mean "woman's river" (50). There can be no doubt that the settlement and river referred to were on the eastern edge of Albemarle Sound; White's and De Bry's maps so designated the village, and Lane clearly indicated an eastern location in a passage describing his return from exploring the Roanoke River: "I thought it good for us to make our returne homeward [i.e., toward Roanoke Island], and that it were necessary for us to get [to] the other side of the Sound of Weopemeiok in time, where wee might be relieved upon the weares [weirs] of Chypanum and the womens Towne" (51).

Lane's enumeration of Weapemeoc towns lists Chepanoc, or Chypanum, between Pasquenoc and Weapemeoc, and it was probably likewise geographically situated between them, east of the latter and west of the former. It is missing from White's original map, but on De Bry's chart "Chapanun" (52) is placed on a river approximately midway between Pasquenoc (Camden Point) and the Chowan River. Transferred to a modern map this would be Perquimans River. Hawks places "Chepanock . . . in the lower part of Perquimons county, near the sound" (53), but De Bry's map has the town up the river a distance, perhaps near present Hertford; Smith's map, which was but a copy of De Bry's, shows Chepanu in the vicinity of modern Chapanoke, in Perquimans County, and there is no doubt that the present town's name was derived from the Indian term. However, Chepanoc may have been located on Harvey or Stevenson Point, on either side of the mouth of Perquimans River, for there is no reference in any of the relations to the explorers ascending rivers other than the Chowan, Roanoke, Pamlico, and perhaps the Neuse. Lane placed it "about the waters side" of Albemarle Sound and elsewhere stated that "upon Easter day [1586] in the morning, the winde comming very calme, we entred the sound [at the mouth of Roanoke River], and by foure of the clocke we were at Chipanum . . . The next morning wee arrived at our home, Roanoak" (54). This definitely locates the town some distance east of the Chowan and Roanoke Rivers, with a site "on Albemarle sound, in Perquimans county" (55) perhaps as near as can be come to the matter.

It is clear that Weapemeoc was the name of a town as well as of the tribe, but it is impossible to locate the town exactly, as the district, rather than the settlement, is the only location by that name that occurs on the maps of White and De Bry. White's four Weapemeoc towns occur on his map north of the western part of the Sound, in the area of present southeastern Chowan and western Perquimans Counties. Lane's list of towns north of the Sound implies that Weapemeoc was west of Chepanoc, which we have already located on Perquimans River. The tribal town and chief's residence may have been on the Yeopim River near its mouth, and it is altogether possible that Yeopim as the name of the river is a contraction of Weapem-eoc (56). It is impossible to support Mooney's statement that the town "seems to have been in Pasquotank county," and Tarbox's allusion to it as "in what is now Perquimans or Pasquotak County" is a mere guess, made without reference to contemporary cartography and based upon a misunderstanding of Lane's narrative in which his note is offered as explanation (57).

White's map shows Mascomenge as a Weapemeoc town, and De Bry's map locates Mascoming in what would now be southern Chowan County, near or at modern Edenton. Smith's map copies the name from De

Bry but places the town inland from the sound (58). Lane's statement that "from Muscamunge we enter into the (Chowan) River and jurisdiction of Chawanook" (59) indicates the town was in southern Chowan County, near the mouth of the river and on the north shore of the sound. This was the interpretation of Mooney, who placed the village "on the northern shore of Albemarle sound, in Chowan county"; Hawks was again incorrect in locating "this town . . . on the lower waters of the [Chowan] river on their eastern side . . . [some distance] above the sound proper" (60).

Lane included Metackwem (Metocaum) among his Weapemeoc towns, and White listed both Warowtani (Maraton) and Cautaking (Catoking) as belonging to the Weapemeoc. It seems possible, however, that all three of these were Chowanoc villages. The evidence is entirely that of location and geographical distribution, but owing to the crudity of early maps and the indefiniteness of early textual references it is impossible to draw tribal boundary lines with exactness. These three towns were in the region that marked the division between the territory of the Chowanoc and the Weapemeoc, and they may have belonged, therefore, to either of the two groups.

The most detailed information concerning the Chowanoc tribe comes from Lane, and his most explicit reference to the "Chawanook . . . Province and Seigniorie" and the towns within it is the one already quoted. He located the town of Chawanook "about 130 miles . . . distant from Roanoak," where "the River beginneth to straighten untill it . . . groweth to be as narrow as the Thames betwene Westminster and Lambeth" (61). The Chowan River begins to straighten and is narrow in the area that separates modern Hertford and Gates Counties, and it is this upper course of the stream that seems to have been the center of Chowanoc territory in 1585. White's map shows Chowanooc on the west bank of the river, just below a small tributary that may have been meant for Wiccacon Creek in eastern Hertford County. This map carries White's symbol for a native town or village, whereas De Bry's and subsequent maps show Chawanook as a district rather than as a town site. On these maps the territory of the tribe is indicated as still farther up-river, in and around the neck of land formed by the convergence of the Meherrin and Nottoway Rivers to form the Chowan. This location makes the Chowanoc the northernmost Algonkian tribe of the Carolina area and indicates that they were the immediate southern neighbors of the linguistically related tribes inhabiting the south bank of the James River in Virginia (62).

The northern position of the Chowanoc is confirmed by the narratives of the Jamestown colony. Both Smith and Strachey mention the "Chawonokes," or "Chawonocks," as among the "many severall nations of sundry languages that environ Powhatans Territories" to the south (63). Smith was told that the "Chawwonocke" lived "one daies journey" from the Nansemond tribe on the Nansemond River (64). In January, 1609, Michael Sicklemore, a member of the Jamestown colony, was sent from Warraskoyak (Burwell's Bay, James River, northern Isle of Wight County, Va.) to "Chowanoke" with Warraskoyak Indian guides to look for Raleigh's lost colonists and for silk grass. He returned with "little hope and less certainetie" of the fate of the lost Englishmen, reporting the river to be "not great, the people few, the country mostly over growne with pynes, where there did grow here and there straglingly Pemminaw, [which] we call silke grasse. But by the river the ground was good and exceeding furtill" (65). Thirteen years later, in February, 1622, John Pory went to "the South River Chawonock, some sixtie miles over land" from Jamestown, and reported finding "a very fruitfull and pleasant Country, yielding two harvests in a yeare, and . . . much of the Silke grasse." He was "kindly used by the people" there, although we are told nothing of their number or condition at that time (66). They were probably reduced in number, for by the middle of the century they were a mere remnant of the strong and numerous group described in 1585. They were referred to in 1650 as friends of the Powhatan tribes of Virginia and as the enemies of the Iroquoian-speaking Tuscarora, Meherrin, and Not-

taway tribes then inhabiting the Roanoke River region and the area west of the Chowan (67).

The Chowanoc were described as the leading tribe north of Albemarle Sound at the time of the Roanoke settlement. Lane referred to them as a "more valiant people and in greater number" than other tribes of the region (68) and reported that Chawanook, the chief town of the tribe, was "able to put 700 fighting men into the fielde, besides the force of the Province itselfe" (69). He also had heard of and believed that a "generall assembly" had been called by Menatanon, the Chowanoc chief, consisting "of all his Weroances and allies to the number of three thousand bowes." Among Chowanoc allies in this instance were the Mangoak, who were reported as "able of themselves to bring as many more to the enterprise" of the tribal conspiracy against the English (70). These figures are clearly exaggerated, for they were given Lane by Pemisapan, who was attempting to impress the English with the great strength of the natives in case of trouble with the colonists. There was no town in this part of native America with as many as 700 warriors, or a total population of 2,000 to 2,500. It is well to remember Hariot's sober observation that "their Townes are but small, and neere the Sea coast but fewe, some contayning but tenne or twelve houses, some 20; the greatest that we have seen hath bene but of 30 houses" (71).

Hariot's *Report* has several other passages that may apply to the Chowanoc. We can not be sure that Hariot was among the colonists who explored the Chowan River, for he says that "some of our company . . . have wandered in some places where I have not bene" (72), but that he was on one of the expeditions of western exploration—either that of the Chowan or of the Roanoke River—is certain, for he stated that "sometimes we made our journeys further into the maine," and he described the physical features of the inland area as one could only from personal observation. He observed that the interior was "more inhabited with people, and of greater pollicie [governments] and larger dominions, with greater townes and houses" (73). Discussing the number of villages to be found within a tribal territory, he said that "in some places of the Countrey one onely towne belongeth to the government of a Wiroans or chiefe Lord, in other some two or three, in some six, eight, and more. The greatest Wiroans that yet wee had dealing with had but eighteene townes in his government, and able to make not above seven or eight hundreth fighting men at the most" (74). It is probable that Hariot here referred to the Chowanoc tribe, for Lane called it "the greatest Province" and was particularly impressed with the power of its chief and the size and strategic situation of its towns. With respect to tribal population Hariot is almost certainly more correct than Lane, and if we allow the whole tribe, rather than one of its towns, a warrior population of 700 to 800, its total population may have been approximately 2,500. Mooney's figure of 1,500 for the period of first contact is an estimate that errs on the side of conservatism (75).

If the Chowanoc tribe had 18 towns at the time of the Roanoke colony, we know the names of less than half of them. This is not a surprising circumstance when it is realized that there is record of only one visit of the English to the area of the upper Chowan River. It seems reasonable to suppose that the town of Chawanook, from which both the river and the tribe took its name, was located in the approximate geographical center of the territory of the tribe, and, as we have seen, both Lane's description and White's map locate the town on the upper river. This would place the tribal capital, i.e., the chief's residence, at a site in either eastern Hertford County or southern Gates County. The sense of the relations is unanimously to the effect that the nucleus of Chowanoc territory and the center of tribal strength were in this region. On this basis Mooney located the tribe, perhaps too far northwestward, "on Chowan river, about the junction of Meherrin and Nottaway rivers" (76). and Tarbox stated that "the country of Chawanook appears to have been about the upper waters of Chowan River" (77). Hawks located the tribe somewhat farther to the south; in one reference he placed the "jurisdiction of Chawanook . . . on the upper waters of the Cho-

wan" and placed the town "on the eastern side of Chowan [River] . . . below the point at which Bennet's Creek enters the Chowan. It was in the northern part of Chowan county" (78). Elsewhere, however, he found it "hard to resist the conviction that the name of the town is retained in the county we now call Chowan; and if so, the locality of Chawanook was in that district of country." His first proposition is correct, but his conclusion is wrong, for native names in modern nomenclature are unreliable indices of aboriginal location unless supported by collateral information. Hawks's further assumption that "the ancient native town may have been but the predecessor of our Edenton, or at any rate not far from its site" (79), is contrary to the testimony of the contemporary documents he printed.

There were probably Chowanoc towns on the lower course of the river, however. We have seen that the territory of the Weapemeoc tribe included the four northeastern modern counties of North Carolina, and perhaps also the southeastern part of Chowan County. Mooney omitted Chowan County from his statement of Weapemeoc distribution (80), and Speck gives the tribe's location as "north of Albemarle sound, west to Edenton" (81). The Weapemeoc town of Mascoming, near present Edenton, seems to have been near the western boundary of Weapemeoc territory. This location of the boundary leaves the eastern bank of the lower Chowan River and the greater portion of present Chowan County the possession of the Chowanoc tribe in 1585. Speck states that the Chowanoc lived on the eastern bank of the river, west and to the north of Edenton, and his map of tribal locations shows the tribe on both banks of the lower river, extending northward to the region east of the confluence of Meherrin and Nottoway Rivers (82). Contemporary sources indicate Chowanoc distribution to have included the territory adjacent to both banks of the river, to and including that portion of land in present northern Hertford County bounded by Meherrin River to the south and west, Nottoway River to the east, and the Virginia–North Carolina line to the north. This distribution is suggested not only by the northern extension of Chowanoc territory already discussed, but also by Lane's statement that "from Muscamunge [i.e., Edenton] we enter into the River and [into the] jurisdiction of Chawanook" (83). Barlow also understood the Chowan River (which he called the "Nomopana") to be the jurisdiction of the Chowanoc tribe. His account gives the impression that there were two divisions of this tribe—a southern one on the lower river, and a northern division "beyond," i.e., farther up the river: "There descendeth into this Occam [Albemarle Sound] another river, called Nomopana, on the one side whereof standeth a great towne called Chawanook, and the Lord of that towne and countrey is called Pooneno. This Pooneno is not subject to the king of Wingandacoa [Roanoke Island and the mainland west of it and south of Albemarle Sound], but is a free Lord. Beyond this country is there another king, whom they call Menatonon, and these . . . kings are in league with each other" (84). Barlow's information was not first-hand, for his expedition did not explore the river, and he was mistaken in understanding Pooneno to have been the resident chief at Chawanook. Menatonon was then the tribal chief, but Pooneno may have been the chief of one of the lower towns near the mouth of the river. That there were several towns belonging to this tribe is made clear by both contemporary narratives and maps. They can be located with some degree of accuracy as follows:

Chawanook, the principal town of the tribe, was located on the river in the area where present Hertford, Gates, and Chowan Counties meet.

Ohanoak seems to have been the second most important Chowanoc settlement. The only specific reference to it is made by Lane, who says that "Betwene Muscamunge and Chawanook upon the left hand as we pass thither is a . . . Towne which we called The blind Towne, but the Savages called it Ohanoak . . . It is subject to Chawanook" (85). This clearly locates Ohanoak on the western bank of the lower river, in eastern Bertie County, probably below the present town of Colerain. The native town does not occur on White's map, but on De Bry's and Smith's it is shown on the west bank of the

upper river in a position between present Winton and Wiccacon Creek. Smith merely copied from De Bry, and the latter's location is apparently based upon a too northern location of Chawanook. Mooney based his location of Ohanoak on De Bry's map rather than Lane's account, and placed it "on the west side of Chowan river, not far below Nottoway river, probably in Hertford county" (86). Hawks's location "in Bertie [County], on its eastern side, somewhere on the waters of the Chowan" is more accurate, and his suggestion that Roanoke River was named after this town, rather than after the island, is quite possible: "We call it Roanoke, an easy corruption from Ohanoak" (87). It would be interesting to know why the English called Ohanoak the "blind town," but there is no suggestion of the reason in contemporary narratives.

The village of Metackwem (Lane) or Metocaum (Smith) is placed on the De Bry and Smith maps on the west bank of the Chowan River at its mouth, on or near present Salmon Creek. It does not occur on White's map. Mooney lists it as "probably" a Chowanoc town (88), which it would seem to be from the standpoint of location; Lane, however, refers to it as if it were "under the jurisdiction of the king of Weopomeiok" and seems to place it on Albemarle Sound east of Chowan River (89). Following De Bry and Smith, rather than Lane, both Mooney and Hawks located it in southeastern Bertie County, the latter specifying a "few miles north of Walnut Point" (90).

The only evidence for the Chowanoc village of Tandaquomuc is De Bry's map. The term occurs neither in the narratives nor on White's map. Smith failed to copy it from De Bry. The Dutch map of 1621 (91) has it "Tantaquomuck." If De Bry's location is correct the village was on Batchelor Bay, at the west end of Albemarle Sound, between the mouths of Chowan and Roanoke Rivers (92). In this position it would be the southernmost Chowanoc village and on the eastern edge of the territory of the Moratoc.

The village of Waraton, or Maraton, may have belonged to the Weapemeoc rather than Chowanoc tribe. White's map designates it as of the Weapemeoc group. Lane does not mention it by name, but on De Bry's and Smith's maps it is placed on the east bank of the lower Chowan River, De Bry giving it a somewhat more southern location than Smith. Smith's location corresponds to that of the modern village of Mavaton in south central Chowan County, a town that evidently took its name from the Indian word. If a Chowanoc village, it was the only one whose name has been preserved located east of the lower course of the river. It is, in fact, the only known Chowanoc village of 1585 located in present Chowan County.

The two other Chowanoc villages whose names have been recorded for us existed in the northern portion of the territory of the tribe. Catoking occurs on the De Bry and Smith maps at the head of Chowan estuary, apparently on the right bank of modern Bennetts Creek at its mouth. This would place it in southern Gates County, and if our location of the town of Chawanook is correct Catoking must have been situated across the Chowan River from the tribal capital. Mooney's location "about Gatesville" (93) places the town too far to the northwest according to all early maps. White's map, in fact, classifies Cautaking as a Weapemeoc town and places it on the north shore of western Albemarle Sound in southern Chowan County. The name is not mentioned in contemporary narratives.

Another town in Chowanoc territory that does not occur on White's map and is not mentioned in the relations but which is found on De Bry's map and on Smith's, is Ramushonoq. These maps place the settlement between the Meherrin and Nottoway Rivers, in northern Hertford County. Speck notes that *l* and *r* were interchangeable in eastern Algonkian dialects and translates *lamushowok* as "small place or little town [Littleton]" (94). Its small size may account for its lack of mention in the earliest sources. It was the most northern Algonkian town located within the limits of present North Carolina for which there is any record in the historical sources of the Roanoke colony. After the Indian troubles of 1675–1676 the Chowanoc ceded this northern tribal land to the Lords Proprietors, but it was soon preempted by the Iroquoian Meherrin and

Nottoway, who pressed down from more northern locations. Their new residence here was used as a pretext for the boundary-line dispute, which was not settled for over 50 years thereafter (95).

The foregoing seven Chowanoc settlements are less than half of the "eighteene townes in his government" that Hariot ascribed to "the greatest Wiroans that wee had dealing with." The Chowanoc tribe was, however, the largest Algonkian tribe of the coastal Carolina area, and it is, therefore, altogether probable that Hariot alluded to the Chowanoc in his reference to the anonymous "greatest Wiroans." The only larger tribe at this time in the entire region of Virginia-Carolina (96) was the Tuscarora, but these natives were neither Algonkian nor a tribe with which the Roanoke colonists had any contacts. They were not described ethnologically until Lawson published his famous *New voyage of a thousand miles thro' several nations of Indians* in 1709.

A final item of tribal history is of interest in connection with the Chowanoc. The Algonkianist William Jones, himself an Algonkian Indian (Fox) trained in linguistics, derived the tribal name from *shawuni*, "south"; *shawunogi*, "they of the south," or "southerners." The same student derived the word "Shawnee," the name of a Southeastern Algonkian tribe at one time resident in South Carolina, from the same source (97). This linguistic relation does not necessarily indicate a close historic connection between the two groups, although Speck has reminded students "that the Chowan may have been a branch of the wide-spread Shawnee." This relationship is unattested by the sparse historical records for the ethnological Southeast, although Speck argues that "it is possible on the basis of name and location" (98).

A third tribe within the area of Algonkian occupation, near its western boundary, was the Moratoc. From the evidence of location and the fact that Moratoc is an Algonkian-sounding word, I classify this group as Algonkian-speaking. This is inadequate evidence upon which to base linguistic classification, but it is practically all there is available. The only word preserved is the name of the town and tribe. The Roanoke River was called the Moratoc until the eighteenth century (99), and it was upon the banks of the lower Roanoke that this tribe lived in 1585–1586. Speck, who shares the opinion that Moratoc is an Algonkian word, analyzes it as "nice [or] good river" and cites an Algonkian analogy in the Malecite word *wolastaguk*, "beautiful, [or] nice river." Lane says that "The Savages of Moratoc themselves doe report strange things of the head of that River, and that from Moratoc it selfe, which is a principall Towne upon that River, it is thirtie dayes as some of them say, and some say fourtie dayes voyage to the head thereof" (100). Lane's statement reveals that the colonists had had contacts with the Moratoc and that the tribe was located on the lower river. Mooney, who relied upon Smith's second-hand account, rather than upon Lane's original narratives, located the Moratoc "160 miles up Roanoke river, perhaps near the south Virginia line" (101). This is clearly an error in conflict with Lane's information. Mooney's reference to them as "an important tribe which refused to hold intercourse with the English" is also incorrect, for Lane refers to them as a group "with whom before wee were entred into a league, and they had ever dealt kindly with us" (102). The English colonists understood only the Algonkian language and the fact that they had been able to receive "reports" from and enter into a "league" with the Moratoc is the best evidence available that this tribe was Algonkian in speech.

The initial friendly relations between the Moratoc and English did not long continue. By the time Lane and his party were ready to explore Roanoke River the Moratoc had been persuaded by Pemisapan that the English were advancing westward as enemies of the native tribes. As the English proceeded up the river they found that the Moratoc had "abandoned their Townes along the River, and retired themselves with their Crenepos (103) and their Corne within the maine, insomuch as having passed three days voyage up the River wee could not meete a man, nor finde a graine of Corne in any [of] their Townes . . . Wee were then 160 miles from home" (104). The experi-

ence of being unable to trade with the natives was disappointing, for the supplies of the colonists at Roanoke were much depleted by the spring of 1586. Lane laments that "wee had no intention to bee hurtful to any of them, otherwise then for our copper to have had corne of them." The English continued their exploration of the river for two more days until their supplies were exhausted and they were forced to return to Roanoke. Their unsuccessful expedition had taken them into the territory of the hostile Mangoak, who were "another kinde of savages, dwelling more to the westward of the said River." The fact that Lane refers to the Mangoak, who were the Iroquoian-speaking Nottoway, and not to the Moratoc as "another kind" of natives is also presumptive evidence that the Moratoc were Algonkian.

Lane's reference indicates that the Moratoc occupied a considerable stretch of land on the lower course of the Roanoke and that there were at least several towns of the tribe located on the banks of the river. De Bry's map shows but one town and locates it on the second northern bend of the river west of Batchelor Bay. This site would be west of Woodward, in southern Bertie County. Moratoc tribal territory in 1585 probably included southern Bertie and northern Martin Counties and may have extended farther northwestward into the present counties of Halifax and Northampton. The latter area was more likely the territory of the Mangoak, however, who are described as the western neighbors of the Chowanoc (105). Moratoc land may also have extended eastward into present Washington County. On White's map the town of Moratuc is on the south bank of Roanoke River, near its mouth, and just east of a tributary that may have been meant for present Welch Creek. If Moratoc holdings extended east to Albemarle Sound it is possible that the villages of Tandoquomuc and Metocaum also belonged to this tribe, rather than to the Chowanoc. In spite of our inability to establish the exact boundaries of the tribe, it is here suggested that we have in the Moratoc an important Algonkian tribe of the Sound area. It is one whose identity and affiliation have never been recognized, probably because of Mooney's early mistake in placing it in the area of Southeastern Iroquoian distribution (105a).

(To be concluded.)

NOTES

(1) E.g., J. Mooney, *The Siouan tribes of the East*, Washington, 1894; J. N. B. Hewitt, "Tuscarora," *Handbook of American Indians* **2**: 842–853, Washington, 1910; J. R. Swanton, "Early History of the Eastern Siouan Tribes," *Essays in anthropology in honor of Alfred Louis Kroeber:* 371–381, Berkeley, 1936; F. G. Speck, "The Catawba Nation and Its Neighbors," North Carolina Hist. Rev. **16**(4): 404–417, 1939. C. W. Milling's otherwise adequate *Red Carolinians* (Chapel Hill, 1940) omits discussion of the Algonkian tribes—another example of their neglect in the history of historical scholarship.

(2) T. Michelson, "Preliminary Report on the Linguistic Classification of Algonquian Tribes," 28th Ann. Rep. Bur. Amer. Ethnol.: 221–290, Washington, 1912.

(3) *Lawson's History of North Carolina, 1714*, edited by F. L. Harriss: 242, 243, Richmond, 1937. All references in this paper will be to this edition of Lawson's *History.*

(4) F. L. Hawks, *History of North Carolina* **1** (1584–1591), Fayetteville, 1857; E. E. Hale, "Original Documents . . . Illustrating the History of Sir Walter Raleigh's First American Colony," Trans. and Coll. Amer. Antiquarian Soc. **4**: 3–33, 317–344, Boston, 1860; I. N. Tarbox, *Sir Walter Raleigh and his colony in America*, Prince Society, Boston, 1884. Hawks and Tarbox reprinted Hakluyt's *Voyages* relating to the Roanoke colony.

(5) The definitive edition of Hakluyt is that of the Hakluyt Society: *The principal navigations, voyages, traffiques and discoveries of the English Nation*, 12 vols., Glasgow, 1903–1905. The Roanoke relations are in vol. 8, pp. 297–422. This edition first included a facsimile of White's original map of the Roanoke region (vol. 8, opp. p. 320). The map is also accurately reproduced in H. S. Burrage, ed., *Early English and French voyages, 1534–1608*, opp. p. 248, New York, 1906.

(6) For De Bry's care-free handling of historical materials, see Chester M. Cate, "De Bry and the Index Expurgatorius," Papers Bibliogr. Soc. Amer. **11**(3–4): 136–140, 1917.

(7) R. G. A(dams), "A Brief Account of Ralegh's Roanoke Colony of 1585," William L. Clements Libr. Bull. **22**: 14, 16, Ann Arbor, 1935.

(8) White's drawings of Indian subjects afford the student a number of ethnographic details not to be found in the written relations of the Roanoke colony. Bushnell published photographic reproductions of White's original drawings ("John White—The First English Artist to Visit America,

1585," Virginia Mag. Hist. and Biogr. **35**(4), 1928, 419–430, 9 pls., 1927; **36**(1): 17–26, 5 pls., 1928; **36**(2): 124–134, 5 pls., 1928). Bushnell reproduced the entire series of native subjects from White's originals in the British Museum, but he did not reproduce the maps.

(9) The most recent reprint of Hariot's *A briefe and true report* is a facsimile reproduction of the 1588 quarto, with an introductory bibliographical essay by Randolph G. Adams (Ann Arbor Facsimile Series, No. 1, 1931). Throughout this paper references to the Roanoke relations, including Hariot's *Report*, will be to the Everyman's Library edition of Hakluyt's *Voyages* (London and New York, vol. 6, 1926). This edition is textually accurate and is the most easily available; moreover, it is unencumbered with inaccurate and misleading interpretive notes such as accompany the reprints by Hawks and by Tarbox (see Note 4).

(10) Hariot's *Briefe report:* 186, 196.

(11) L. S. Livingston, "Introductory Note" to Hariot's *Report*, p. v, New York, 1903 (Dodd, Mead & Co.'s Facsimile Reprints of Rare Books, Historical Series, No. 1).

(12) Hakluyt **6**: 121–132; also in Burrage, *op. cit.:* 225–241.

(13) Hakluyt **6**: 196–227; also Burrage, *op. cit.:* 281–323.

(14) P. L. Phillips suggested a number of other reasons for distinguishing the governor and the artist as separate individuals ("Virginia Cartography," Smithsonian Misc. Coll. **14**(1039): 1–18, 1896). More recently the tendency has been to regard the governor and the artist as the same person (R. G. Adams, "An Effort to Identify John White," Amer. Hist. Rev. **41**(1): 87–91, 1935; W. P. Cummings, "The Identity of John White Governor of Roanoke and John White the Artist," North Carolina Hist. Rev. **15**(3): 197–203, 1938).

(15) White's map of Virginia (see Note 5) is not to be confused with the map of Virginia and Florida also ascribed to him. (*Principal navigations*, vol. **8**: opp. p. 400, Glasgow; also reproduced in E. G. R. Taylor, ed., *The original writings and correspondence of the two Richard Hakluyts* **2**: opp. p. 414, London, 1935). The Virginia-Florida map occurs among White's original drawings and maps in the Grenville Library of the British Museum. It may have been drawn by him, but the Florida portion is a copy of Le Moyne's map and could not have been based upon White's personal experiences of exploration so far as can be judged from the few known facts of his life. The Carolina portion of the second map is a smaller-scale copy of White's map of Virginia, except that it omits several of the native place names of the larger chart.

(16) Hakluyt **6**: 141–162; Burrage, *op. cit.:* 245–271.

(17) De Bry's choice of Hariot's *Report* was recommended by Hakluyt, who was also instrumental in arranging for De Bry's use of White's pictures and maps. For Hakluyt as mediator between White and De Bry, see G. B. Parks, *Richard Hakluyt and the English voyages*, New York, 1928. For the place of Hariot and White in the work and historical record of the Roanoke settlement, see Henry Stevens, *Thomas Hariot, the mathematician, the philosopher, and the scholar.* London, 1900. This biography is inadequate by standards of historical scholarship, but it is the only one available. See also *Dictionary of National Biography* **24**: 437–439, 1890.

(18) The De Bry-White map, "Americae Pars, Nunc Virginia Dicta," has been frequently reproduced, most recently by Adams and by Humphreys. A. L. Humphreys, *Old decorative maps and charts:* pl. 27, London, 1926; R. G. A(dams), *A brief account of Ralegh's Roanoke colony:* opp. p. 18, Ann Arbor, 1935. With undue modesty De Bry represented White as "authore," himself as merely "sculptore." The White map *via* De Bry became a "mother map" of Carolina and was copied by atlas compilers and professional mapmakers for a century. For its influence on maps of coastal North America compare Humphrey's pls. 42 and 56 with pl. 27, and the latter with pls. 20A, 20B, and 21 in C. O. Paullin, *Atlas of the historical geography of the United States*, Washington, 1932. Cf. also pls. 26 and 30 in E. D. Fite and A. Freeman, *A book of old maps*, Cambridge, 1926.

(19) W. L. Ford has discussed late seventeenth-century maps of Carolina in "Early Maps of Carolina," Geogr. Rev. **16**: 264–273, 1926.

(20) Lawson's map was published as a frontispiece of the 1903 (Charlotte) and the 1937 (Richmond) reprints of his *History*. The 1937 edition is superior textually, but the map of the 1903 edition is on a larger scale. Both are poorly reproduced.

(21) Hariot, p. 193.

(22) *Ibid.:* 171, 186.

(23) Lane, "Imployments," in Hakluyt **6**: 141–142, 145, 146. Throughout this paper the original spelling has been retained in all quotations from the sources, but punctuation and paragraphing have been modernized in the interest of preserving the originally intended meaning. All comments in brackets are interpolations by the present writer.

(24) *Ibid.:* 142, 147, 155, 158.

(25) See articles "Nadowa" and "Nottoway" in *Handbook of American Indians* (hereafter referred to as *HAI*), Bur. Amer. Ethnol. Bull. 30, **2**: 8–9, 87, 1910. The eponym was an opprobrious epithet meaning "rattlesnake." Carolina maps from 1590 (De Bry-White) to *c.* 1660 locate Mangoak territory west of the area of Algonkian occupation. This location is based upon Lane's account, as Mangoak is absent from White's map.

(26) Hakluyt **6**: 132–139. This *Voyage* is sometimes ascribed to Lane but may have been written by Grenville (Tarbox, p. 130n).

(27) This episode marks the beginning of the hostility between the natives and the English which culminated in the "Conspiracy of Pemisapan." Until the sack of Aquascogoc the natives had been friendly. Thereafter Algonkian hostility was a factor in the failure of the Roanoke settlement (see Lane, "The Conspiracie of Pemisapan, the Discovery of the Same, and at the Last, . . . our Request to Depart with Sir Francis Drake for England," Hakluyt **6**: 152–162).

(28) *Ibid.:* 137–139.

(29) Occam was the native word for the body of water including the northern portion of Pamlico Sound and Albemarle Sound. Barlow was mistaken in thinking of it as a "river."

(30) White's drawing of Pomeiock shows a similarly stockaded village. White's original has been reproduced by Bushnell and by Binyon. (Bushnell, "John White the First English Artist to Visit America, 1585," Virginia Mag. Hist. and Biogr. **35**(4): pl. 7, opp. p. 428; and "Virginia—from Early Records," Amer. Anthrop. **9**: opp. p.

32, 1907; L. W. BINYON, "The Drawings of John White," Walpole Soc. Publ. **13**: pl. 27, New York, 1925.)

(31) In this context Occam refers to Albemarle Sound.

(32) "Wingandacoa" was understood by Barlow to refer to Roanoke Island and the adjacent mainland. Gerard has pointed out that as a locative the term is an "impossible corruption, due to mishearing" a native word supposed to have been *Wingatakw*, meaning "good clothes." (GERARD, *HAI* **2**: 957–958.) Raleigh detected Barlow's error, although one wonders how he did so, for in his *History of the world* he wrote: "When some of my people asked the name of the country, one of the savages answered Wingan-da-coa, which is as much as to say 'You wear good clothes' or 'gay clothes.'" (Cited by GERARD, *HAI* **2**: 957, and by HAWKS, *History of North Carolina* **1**: 78–79, 1859.)

(33) Amadas and Barlow returned to England in September, 1584, taking with them Manteo and Wanchese, "Two of the Savages, being lustie men." These natives remained in England until April of the next year, when they were brought back to Carolina by Grenville and Lane. Manteo remained a faithful friend of the English colonists, while Wanchese turned against them and became a principal factor in the "conspirary of Pemisapan." Barlow's reference to these men as being in England would seem to date his relation as having been written late in 1584 or early in 1585.

(34) BARLOW, "The First Voyage," in Hakluyt **6**: 127–131.

(35) The only other approach toward aboriginal history would be by archeology, but there has been no scientific archeological excavation in coastal Carolina to date.

(36) E.g., "Wingandacoa"; see above, Note 32.

(37) In modernizing the native terms as spelled by the early writers in most instances I have followed the Bureau of American Ethnology "Synonymy" (*HAI* **2**: 1021–1178). Speck feels that the Carolinian term *weopim* is cognate with Nanticoke *winquipim*, "sweet fat" or "bear" ("The Nanticoke and Conoy Indians," Papers Hist. Soc. Delaware, new ser., 1: 51, Wilmington, 1927). *Weopim-ok* would thus indicate "bear place"—an appropriate term for this part of Carolina. (SPECK, personal information; *idem*, "Chapters on the ethnology of the Powhatan tribes of Virginia," Indian Notes and Monog. **1**(5): 280, 1928: J. LAWSON, *History of Carolina*: 119–121, 1937 reprint.)

(38) The Algonkian tribes from Maryland to Carolina used the word *wiroans* (Hariot), *wiroance* (White), *weroance* (Lane), *werowance* (Smith), to designate a chief, head-man, or "king." Lane's *weroanza* thus refers to "queen." Strachey used "weroancqua" for a native "woman queene" or female chief. (*Historie of Travaile into Virginia Britannia* (*c.* 1616): 56, 196, London, 1849). The word derives from *wiro*, "to be rich"; a chief was "a rich man" or "one who exists in affluence" (GERARD, Amer. Anthrop. **9**: 112, 1907; SPECK, *op. cit.*: 275.

(39) Hakluyt **6**: 154.

(40) Pemisapan was the same chief whom Barlow had heard of as "Wingina, . . . king [of] . . . the country Wingandacoa" (Hakluyt: 124). But "Pemisapan . . . had changed his name of Wingina upon the death of his brother Granganimo" (Lane, *in* Hakluyt: 146). We are not informed as to the exact nature of the local custom involved in this instance of name-changing; for Algonkian names and naming customs in Virginia, see Strachey, *op. cit.*: 48, 111.

(41) Lane, *in* Hakluyt **6**: 155, 157. Lane's relation of Okisko's part in the conspiracy hardly justifies Thomas's remark that "Lane accused him of being the leader in the plot formed by his tribe . . . and other Indians to massacre the colonists" (*HAI* **2**: 115).

(42) Smith suggested a warrior to total population ratio of 3 to 10 for 5,000 aborigines within 60 miles of Jamestown (*Map and description of Virginia*, 1612, in E. ARBER, ed., *Travels and works of Captain John Smith*: 65, 360, 1884). Swanton has used a ratio of 1 to 3½ for the tribes of the Southeast (*Indian tribes of the Lower Mississippi Valley*: 39–45, 1911; *Early history of the Creek Indians and their Neighbors*: 421–456, 1922. The latter is an extensive study of the "Population of the Southeastern Tribes" but excludes the Carolina Algonkian).

(43) A. L. KROEBER has made the most competent and comprehensive examination of native American population to date (*Cultural and natural areas of native North America* (ch. 11): 131–181, 1939); that "the vast majority of figures by contemporaries are too large" (p. 180) is one of his concluding "methodological principles."

(44) "The Aboriginal Population of America North of Mexico," Smithsonian Misc. Coll. **80** (7): 6, 1928.

(45) Smith's map of Virginia strikingly shows this, and archeology has proved Smith's map to be remarkably accurate in its location of native town sites. (D. I. BUSHNELL, JR., "Indian Sites below the Falls of the Rappahannock," Smithsonian Misc. Coll. **96**(4): 1–65, 1937; M. A. MOOK, "The Anthropological Position of the Indian Tribes of Tidewater Virginia," William and Mary Coll. Quart. Hist. Mag. **23** (1): 27–40, 1943; and, "The Ethnological Significance of Tindall's Map of Virginia, 1608," *ibid.*, 23 (4): 371–408, 1943.

(46) MOONEY, article "Weapemeoc," *HAI* **2**: 926.

(47) *History of Carolina*, 1937 reprint, p. 255.

(48) *HAI* **2**: 207.

(49) *History of North Carolina* **1**: 112.

(50) SPECK, personal information; GERARD, cited by Mooney, *HAI* **2**: 207.

(51) Hakluyt **6**: 147. The early sources (except Barlow) refer to Albemarle Sound as the "Sound of Weopemeiok." "Weares" refer to wicker structures within which the natives trapped fish; White's drawing of "The Manner of their fishing" shows the method of their construction (Bushnell, 1927, pl. 6, opp. p. 427; Binyon, pl. 26. Cf. these reproductions of White's original with De Bry's pl. 13 for an illustration of the liberties De Bry took in "reproducing" White's drawings).

(52) Apparently a misprint for Chepanun or Chepanum; Smith's map had Chepanu, the Dutch map of 1621 has Chapanun. Until the so-called Horne map of 1666, maps of the Roanoke region were largely copies of De Bry-White. (See Note 18.)

(53) *History of North Carolina* **1**: 113.

(54) Hakluyt **6**: 150.

(55) *HAI* **1**: 244.

(56) Mooney equated the Weapemeoc with the Yeopim, both in name and in identity. The latter is regarded as a later "band or sub-tribe" of the former (*HAI* **2**: 927, 1176; *The Siouan tribes of the East:* 7, 1894).

(57) MOONEY, *HAI* **2**: 926; TARBOX, *Sir Walter Raleigh and his colony in America:* 140n, 1884.

(58) Smith's *Works*, Arbor ed., opp. p. 342; in Smith's paraphrase of Lane's account the name is spelled Muscamunge (*op. cit.:* 312).

(59) Hakluyt **6**: 142.

(60) MOONEY, *HAI* **1**: 810; HAWKS **1**: 113; Hawks based his judgment on Smith's map of 1624, which was by no means a contemporary document and was a copy from De Bry's map, which, in turn, was a free copy from White's. "Nothing is more persistent than a geographical error, unless it be an historical error."

(61) Hakluyt **6**: 142.

(62) For the locations of James River tribes in 1607 see M. A. MOOK, "Virginia ethnology from an early relation," William and Mary Coll. Quart. Hist. Mag. **23**(2): 101–129, 1943.

(63) SMITH, *Map and description of Virginia*, 1612, in Arber, p. 55; STRACHEY, *Historie, c.* 1616, p. 41. Strachey's passage is a practically verbatim repetition of that of Smith.

(64) SMITH, *True relation*, 1608, Arber, p. 32.

(65) *The proceedings and accidents of the English conony in Virginia*, 1612, in Arber edition of Smith's *Works*, pp. 132, 158, 474.

(66) SMITH, *Generall historie*, 1624, Arber, p. 590.

(67) EDWARD BLAND (and others), "The Discovery of New Brittaine, Begun August 27, 1650" (London, 1651), in A. S. Salley, ed., *Narratives of early Carolina:* 8–19, 1911.

(68) Hakluyt **6**: 157.

(69) *Ibid.:* 142. Mooney is mistaken in ascribing 700 warriors to the Chowanoc town of Ohanoak, rather than to the tribal capital of "Chawanook" (*HAI* **1**: 292). Lane's meaning is perfectly clear in his narrative as printed by Hakluyt; Mooney's error is based upon Smith's garbled version of Lane in his *Generall historie* (Arbor, p. 312).

(70) *Ibid.:* 146.

(71) "Briefe and True Report," Hakluyt **6**: 186.

(72) *Ibid.:* 184.

(73) *Ibid.:* 194. The Oxford English Dictionary gives the sixteenth-century meaning of "policy" as "organized state, [or] commonwealth."

(74) *Ibid.:* 186–187.

(75) MOONEY, *The aboriginal population of America north of Mexico:* 6, 1928.

(76) *HAI* **1**: 292.

(77) *Sir Walter Raleigh and his colony in America:* 146n.

(78) *History of North Carolina* **1**: 112–113.

(79) *Ibid.:* 74.

(80) *HAI* **2**: 926.

(81) "The Ethnic Position of the Southeastern Algonkian," Amer. Anthrop. **26**(2): 187, 1924.

(82) *Ibid.:* 188–189.

(83) Hakluyt **6**: 142.

(84) *Ibid.:* 129.

(85) *Ibid.:* 142.

(86) *HAI* **2**: 111.

(87) *History of North Carolina* **1**: 113.

(88) *HAI* **1**: 292, 851.

(89) Hakluyt **6**: 142.

(90) MOONEY, *HAI* **1**: 951; Hawks **1**: 113.

(91) *Documents relative to the colonial history of the State of New York*, edited by E. B. O'CALLAGHAN, vol. 1, frontispiece.

(92) *HAI* **2**: 685.

(93) *HAI* **1**: 219.

(94) SPECK, *The Nanticoke and Conoy Indians:* 56, 57, 1927; MOONEY, *HAI* **1**: 292; **2**: 354.

(95) See R. D. W. CONNOR, *History of North Carolina* **1**: 50–51, for the so-called Chowanoc "war" with the colonists; **1**: 70–71, for Meherrin occupation of former Chowanoc territory.

(96) See MOONEY, *Aboriginal population:* 6, 1928, for comparative tribal population statistics for native Virginia and the Carolinas in 1600. Mooney's figures have been rearranged and reinterpreted by the writer in "The aboriginal population of Tidewater Virginia," scheduled for publication in Amer. Anthrop., April, 1944.

(97) *HAI* **1**: 292; **2**: 530–538.

(98) American Anthropologist **26**(2): p. 187, n. 4, 1924.

(99) Roanoke River is designated Moratoc on the maps of Smith (Arber, opp. p. 342), Horne (1666), Ogilby (1671), and Lawson (1709). The last three are reproduced in O. M. MCPHERSON, *Indians of North Carolina* (Senate Doc. 677): 89, 91, facing p. 100, 1915.

(100) Speck, personal information; Hakluyt **6**: 145. The "strange things" reported from the head of the river were an inland sea and a "Mineral Countrey," wherein the natives are said to have mined "*Wassador*, which is copper." (*Ibid.:* 145–151. Hariot also reported copper and silver as products utilized by the natives of the inland country; *Briefe report*, Hakluyt, p. 171.)

(101) *HAI* **1**: 942, based upon Smith's *Generall historie* (Arber, p. 312).

(102) Hakluyt **6**: 146.

(103) *Crenepo* meant "woman," according to the vocabularies of Smith and Strachey (Smith's *Works*, Arber, pp. 44, 381; STRACHEY, *Historie*, p. 185). Gerard derived the word from *kerenepeu*, "she carries water," i.e., "water-carrier." (Amer. Anthrop. **6**(2): 324, 1904; **7**(2): 235–237, 1905.)

(104) Hakluyt **6**: 146.

(105) "Overland from Chawanook to the Mangoaks is but one dayes journey from Sunne rising to Sunne setting, whereas by water [i.e., down Chowan River and up the Roanoke] it is seven dayes with the soonest" (Lane, pp. 149, 151).

(105a) I have discussed Moratoc tribal identity and location in "A Newly Discovered Algonkian Tribe of Carolina," Amer. Anthrop., new ser., **45**(4): 635–637, 1943.

PROCEEDINGS OF THE ACADEMY AND AFFILIATED SOCIETIES

THE ACADEMY

46TH ANNUAL MEETING OF THE ACADEMY

The 46th annual meeting of the Academy, held in the Auditorium of the Cosmos Club, on January 20, 1944, after the 323d meeting of the Academy, was called to order at 9:40 P.M. by the President, Dr. LELAND W. PARR, with 37 persons in attendance.

The minutes of the 45th annual meeting were approved as published in the JOURNAL 33: 110–116. 1943.

The reports of several officers and of the Committees of Auditors and Tellers were read and accepted. These reports are recorded at the end of the minutes.

After the acceptance of the report of the Committee of Tellers, the President declared the following duly elected to the given offices:

CLEMENT L. GARNER, *President*
F. G. BRICKWEDDE, *Secretary*
HOWARD S. RAPPLEYE, *Treasurer*
WILLIAM A. DAYTON, *Board of Managers to January 1945 to fill an unexpired term*
HENRY G. AVERS, *Board of Managers to January 1947*
FRANCIS M. DEFANDORF, *Board of Managers to January 1947*

The Secretary presented for the Affiliated Societies their nominations for Vice-Presidents of the Academy as follows:

Philosophical Society of Washington—HAROLD F. STIMSON
Anthropological Society of Washington—T. DALE STEWART
Biological Society of Washington—HARRY B. HUMPHREY
Chemical Society of Washington—EDGAR R. SMITH
Entomological Society of Washington—AUSTIN H. CLARK
National Geographic Society—ALEXANDER WETMORE
Geological Society of Washington—HERBERT INSLEY
Medical Society of the District of Columbia—FRED O. COE
Columbia Historical Society—GILBERT H. GROSVENOR
Botanical Society of Washington—L. EDWIN YOCUM
Archaeological Society of Washington—Not functioning for the duration of the National Emergency
Washington Section of the Society of American Foresters—WILLIAM A. DAYTON
Washington Society of Engineers—FRANK B. SCHEETZ
Washington Section of the American Institute of Electrical Engineers—FRANCIS B. SILSBEE
Washington Section of the American Society of Mechanical Engineers—WALTER RAMBERG
Helminthological Society of Washington—EMMETT W. PRICE
Washington Branch of the Society of American Bacteriologists—RALPH P. TITTSLER
Washington Post of the Society of American Military Engineers—WILLIAM N. CORSE
Washington Section of the Institute of Radio Engineers—HERBERT GROVE DORSEY
Washington Section of the American Society of Civil Engineers—OWEN B. FRENCH

The Secretary was instructed by the members present to cast a unanimous ballot for these nominees.

The President, Dr. Parr, announced the recipients of the Academy's Awards for Scientific Achievement for 1943 as follows:

For the Biological Sciences, to JASON R. SWALLEN, Office of the Coordinator of Inter-American Affairs, in recognition of his outstanding contributions to agrostology.

For the Engineering Sciences, to LLOYD V. BERKNER, Commander, U.S.N.R., in recognition of his distinguished service in research on the ionosphere and wave propagation.

For the Physical Sciences, to LAWRENCE A. WOOD, National Bureau of Standards, in recognition of his distinguished service in the investigation of rubber and other high polymers.

The Retiring President announced the appointment authorized by the Board of Managers of a "Committee to Study the Place and Function of an Academy of Sciences in Washington," consisting of AUSTIN H. CLARK, chairman, JOHN E. GRAF, HARRY B. HUMPHREY, RAYMOND J. SEEGER, PAUL A. SMITH, and two additional members to be appointed upon recommendation of Chairman Clark by the incoming President, Capt. CLEMENT L. GARNER. Dr. Parr pointed out that it is intended that this Committee will consider the Academy in rela-

tion to the changed conditions that will probably exist after the war.

The Retiring President, Dr. Parr, appointed Past Presidents Tuckerman and Chambliss to escort the incoming President, Capt. Clement L. Garner, to the Chair. After a short address, Captain Garner adjourned the meeting.

Report of the Secretary

During the Academy year there were a total of 49 persons (45 resident and 4 nonresident) elected to membership. Of these 49 persons elected, 35 resident and 4 nonresident have qualified for membership, 2 accepted resident membership but have not qualified by payment of dues, and 2 persons declined membership. Six just recently elected have not yet been notified of their election. The new members were distributed among the various sciences as follows: 4 each in biochemistry, mathematics, and physical chemistry; 2 each in physics, cytology, anthropology, geochemistry, entomology, and paleontology; and 1 each in biology, physiology, chemistry, civil engineering, geology, zoology, dendrology, botany, hydraulics, forest ecology, geophysics, hydrology, astronomy, chemical economics, and ichthyology.

Because of their retirement from the active practice of their profession, 8 members (5 resident and 3 nonresident) were placed on the retired list to enjoy all the privileges of active membership without further payment of dues. Resignations were accepted from 4 members in good standing (1 resident and 3 nonresident). One resident and two nonresident members were dropped for nonpayment of dues.

The deaths of 19 members (10 resident and 9 nonresident) were reported, as follows:

William Crozier, Washington, D. C., November 10, 1942.

Frank D. Adams, Montreal, Canada, December 9, 1942.

Leonhard Stejneger, Washington, D. C., February 28, 1943.

Mary Jane Rathbun, Washington, D. C., April 4, 1943.

William A. Hoffman, San Juan, Puerto Rico, April 4, 1943.

William A. Setchell, Berkeley, Calif., April 5, 1943.

Allen C. Clark, Washington, D. C., May 16, 1943.

Richard F. Jackson, Washington, D. C., June 1, 1943.

Charles F. Marvin, Washington, D. C., June 5, 1943.

Edward H. Bowie, San Francisco, Calif., June 29, 1943.

George W. Littlehales, Washington, D. C., August 14, 1943

Leon W. Hartman, Reno, Nev., August 27, 1943.

Aleš Hrdlička, Washington, D. C., September 5, 1943.

Charles E. Resser, Washington, D. C., September 18, 1943.

Nathan S. Osborne, Washington, D. C., September 18, 1943.

Elmer D. Ball, Pasadena, Calif., October 5, 1943.

Frank Leverett, Ann Arbor, Mich., November 15, 1943.

Edward W. Parker, Philadelphia, Pa., January 3, 1944.

George Otis Smith, Skowhegan, Maine, January 10, 1944.

Of these Leonard Stejneger, Mary Jane Rathbun, Charles F. Marvin, and George W. Littlehales were original members. Leonhard Stejneger was also an honorary member.

On January 20, 1944, the status of the membership was as follows:

	Regular	*Retired*	*Honorary*	*Patron*	*Total*
Resident....	429	35	2	0	466
Nonresident.	135	25	16	1	177
Total.....	564	60	18	1	643

The net changes in membership during the past year are as follows:

	Regular	*Retired*	*Honorary*	*Patron*	*Total*
Resident....	+19	−2	−1	0	+16
Nonresident.	− 5	+2	0	0	− 3
Total.......	+14	0	−1	0	+13

During the Academy year 1943 the Board of Managers held 6 meetings, with an average attendance of 17 persons.

During the year the following important matters were before the Board for consideration:

(1) The Washington Academy of Sciences became affiliated with the American Association for the Advancement of Science in 1942, and in 1943 the Academy received from the American Association for the Advancement of Science the Academy's first A.A.A.S. grant for research, this grant amounting to $150. The amount was determined by taking the actual

number of members of the Academy who were in good standing in the Association at the close of the Association's fiscal year ended September 30, 1942, allowing 50 cents each for such paid-up members. The main purpose of the A.A.A.S grants to Affiliated Academies has been to aid young and promising scientists who have worthwhile research projects but lack the funds to continue work on them. The funds may be used for the purchase of necessary equipment or supplies, or for compensation to an assistant, but are not to be used for publication. Research grants may be accumulated for a period of 3 years. Upon recommendation of a special committee consisting of Frank H. H. Roberts, Jr., Chairman, R. J. Seeger, and R. P. Tittsler, the Academy decided to allow the first A.A.A.S. grant to be accumulated with the grant for 1944. We have already been informed that the grant for 1944 is $207.50, making a total of $357.50 available now to the Academy. This may be awarded during the present year or allowed to accumulate with the grant for 1945.

(2) On September 16 the District of Columbia Dental Society, a component of the American Dental Society, requested affiliation with the Academy. A special committee consisting of F. B. Scheetz, Chairman, Charlotte Elliott, and R. P. Tittsler, was appointed to study the qualifications of the District of Columbia Dental Society for affiliation with the Academy and to report its findings to the Board of Managers. The application of this Society is still pending.

(3) The Board of Managers approved a request of the Board of Editors of the Journal that 50 free reprints of obituaries published in the Journal be furnished to the writers.

(4) The Standing Rules of the Board of Managers were amended to permit payment of dues for fractional parts of a year.

(5) The bylaws were amended by vote of the Academy to permit Academy members to buy life membership by payment of a sum that will provide an annuity certain of $5 a year for a period of years equal to 70 minus the age of the member at the time life membership is bought.

(6) In December the Academy was requested to vote upon an amendment to the bylaws that would extend life membership to all members of the Academy upon retirement from the gainful practice of their profession because of age or disability. The Committee of Tellers will report this evening upon the results of this ballot.

Noteworthy, also, were the efforts this year of officers of the Academy with budgetary allotments to reduce expenditures of their offices consistent with efficient operation. The economies of operation effected during 1943 may not be possible of attainment in future years.

During the Academy year, seven meetings of the Academy were held as follows, beginning with the 317th and ending with the 323d:

On February 18, 1943, Harvey L. Curtis presented an address as retiring president entitled *A scientific recreation—The accuracy and extent of measurement.*

On March 18, 1943, the 1942 Academy Awards for Scientific Achievement were presented to Robert S. Campbell, of the U. S. Forest Service, for work in the biological sciences; to Walter Ramberg, of the National Bureau of Standards, for work in the engineering sciences; and to Milton Harris, of the National Bureau of Standards, for work in the physical sciences.

On April 22, 1943, Linus Pauling, of the California Institute of Technology, addressed a joint meeting of the Chemical Society of Washington and the Academy on *Chemical studies of the structures of antibodies.*

On October 21, 1943, Stephen P. Mizwa, secretary and executive director of the Kosciusko Foundation, addressed the Academy on *Nicholas Copernicus.*

On November 18, 1943, Howard Wilcox Haggard, director of the Laboratory of Applied Physiology, Yale University, addressed the Academy on *Andreas Vesalius.*

On December 16, 1943, Fred Corry Bishopp, of the U. S. Bureau of Entomology and Plant Quarantine, addressed the Academy on *Insects and the war.*

On January 20, 1944, William Duncan Strong, professor of anthropology of Columbia University and director of the Ethnogeographic Board, addressed the Academy on *Recent anthropological research in Latin America.*

The meeting on April 22 was held in the Auditorum of the U. S. National Museum; the other six meetings were held in the Assembly Hall of the Cosmos Club.

F. G. Brickwedde, *Secretary.*

Report of the Treasurer

CASH RECEIPTS AND DISBURSEMENTS

Receipts

From dues 1939	$ 5.00
From dues 1940	35.00
From dues 1941	40.00
From dues 1942	115.00
From dues 1943	2,610.92
From dues 1944	40.00
From life membership	79.47
From subscriptions 1942	23.40
From subscriptions 1943	398.45
From subscriptions 1944	408.45
From subscriptions 1945	2.70
From sales of Journal	72.20
From sales of directory, 32d Edition	.25
From sales of directory, 33d Edition	.25
From payments for reprints 1942	203.83
From payments for reprints 1943	430.67
From interest on investments	1,191.19
From credit memo (Am. Sec. & Tr. Co.)	7.50
From refund to meetings committee	4.50
From T. Q. Donaldson (note—paid off)	1,000.00
Total receipts	$6,668.78
Cash balance, Jan. 1, 1943	1,506.06
To be accounted for	$8,174.84

Disbursements:

For Secretary's Office 1942	$ 97.25
For Secretary's Office 1943	144.01
For Treasurer's Office	111.27
For Custodian & Subs. Mgr. 1942	12.00
For Custodian & Subs. Mgr. 1943	16.03
For Journal printing 1942	187.11
For Journal printing 1943	2,308.88
For Journal reprints 1942	141.75
For Journal reprints 1943	349.33
For Journal illustrations 1942	2.34
For Journal illustrations 1943	247.41
For Journal Office 1942	23.61
For Journal Office 1943	225.46
For Meetings Committee 1942	38.00
For Meetings Committee 1943	187.53
For Directory	27.37
For debit memos, refunds, etc.	26.85
For Series G Bond	1,000.00
Total disbursements	$5,146.20
Cash balance Dec. 31, 1943	3,028.64
Total	$8,174.84

RECONCILIATION OF BANK BALANCE

Balance as per cash book, 12-31-43			$3,028.64
Bank Balance, Am. Sec. & Tr. Co., as per statement 12-31-43		$3,045.79	
Receipts not deposited		39.30	
		$3,085.09	
Checks outstanding, not cashed:			
No. 170	$21.50		
958	3.00		
963	0.95		
964	18.88		
965	12.12	56.45	
			$3,028.64

INVESTMENTS

409 Shares stock of Washington Sanitary Improvement Co., par value $10 per share, cost	$4,090.00
20 Shares stock Potomac Elec. Power Co., 6% Pref., cost	2,247.50
4 Certificates Corporate Stock of City of New York, 1 for $500, 3 for $100, cost	800.00
1 Bond of Chicago Railways Co., #1027; interest at 5%, due 1927, par value $1,000, less $250 paid	750.00
2 Real-estate notes of Yetta Korman et al., dated Oct. 5, 1938, renewed 1941, for 3 years (#7 of 37 for $500 and #8 of 37 for $500), cost	1,000.00
2 Certificates (1 for $4,000 and 1 for $1,000) First Federal Savings & Loan Assn. Nos. 914 & 1063	5,000.00
2 Certificates (1 for $4,500 and 1 for $500) Northwestern Federal Savings & Loan Assn. Nos. 1380 and 1441	5,000.00
5 U. S. Government Series G Bonds at $1,000 each, Nos. M332990G, M332991G, M332992G, M332993G, M180741G	5,000.00
Deposited in Savings Account, American Sec. & Trust Co.	46.65
	$23,934.15
Cash Book balance Dec. 31, 1943	3,028.64
Total Assets	$26,962.79

Total Assets Dec. 31, 1942	$25,404.08
Total Assets Dec. 31, 1943	26,962.79
Increase	$1,558.71

The relatively large increase in the assets of the Academy is more apparent than real. It is impossible at the close of the fiscal year to know exactly what bills are outstanding. We can not even furnish an exact statement as to the relationship between expenditures and allotments, since, for example, we do not yet know exactly what the charges-to-authors increment of the JOURNAL allotment will be. The statement concerning the status of the various allotments will be submitted later as a supplemental report. It is known, however, that, at the time this report is written, $508.40 has been paid out since January 1, 1944, on obligations incurred in 1943 and chargeable to 1943 expenditures. Presumably there will be approximately $50 more that will have to be paid out under these conditions, which leaves the net increase in assets something of the order of $1,000. This results to a great extent from the following:

(1) During the past year we have written off no losses on investments as we have had to do in some recent years.

(2) Officers and committees have apparently stayed well within their budget allotments.

(3) A considerable amount was realized from the collection of back dues.

(4) One life membership was received during the year.

(5) In spite of the fact that 1943 would normally have been a "Red Book" year, the Red Book was not issued, and although preparation of it was begun, the expenditures in connection with the work done so far are relatively small.

(6) As has been shown earlier in this report, a considerable amount of money was received on back interest. This should have been collected previously, but owing to a misunderstanding the interim certificates were not exchanged for coupon certificates until during the year 1943 and then all interest for 1940 to 1943, inclusive, on the $800 investment with the City of New York was received in a lump.

The previous report showed an increase of $703.99 with outstanding bills estimated at $300. Actually, as shown earlier in this report, the outstanding bills finally amounted to $502.56.

However, taking all these factors into account, this report still shows a reasonably healthy increase in the total assets of the Academy and is a welcome change from the condition which existed three or four years ago when we were showing a slight deficit year after year. Your Treasurer feels that, if the officers and committees of the Academy are willing to continue being as frugal as possible in connection with Academy expenditures, we may be able to carry on even in these troubled times and continue to make some slow but steady gain in Academy assets. If, as is planned, the Red Book is issued in 1944, the cost of the publication of the Directory will, of course, tend to offset some of the gain shown for this year.

HOWARD S. RAPPLEYE, *Treasurer.*

Report of the Auditing Committee

The accounts of the Treasurer of the WASHINGTON ACADEMY OF SCIENCES for the year 1943 were examined by your auditing committee on January 17, 1944. Each item of disbursement was found to be duly authorized and supported by a canceled check or a debit memorandum except for the outstanding checks listed in the report. The accompanying report of the Treasurer is in agreement with his records. The securities listed in the report were inspected on January 17, 1944, and were found to be as listed and with all coupons attached that are not yet due.

The accounts of the Treasurer were found to be in excellent shape as indicated by careful, systematic, and orderly arrangement of all items. This greatly simplified the work of the committee and deserves the commendation of the Society.*

C. H. SWICK, *Chairman.*
G. F. GRAVATT.

[One member of the auditing committee, Prof. Frank M. Weida, was unable to assist in the audit because of pressure of work following his recent illness.]

Report of the Archivist

There is very little to report this year. It might be mentioned that the material is stored in a convenient place in my office at the U. S. Plant Industry Station, Beltsville, Md., protected from moisture and dirt as much as can be done in an ordinary building. Although not yet catalogued the material is accessible and has been made use of in connection with the work of various committees of the Academy.

NATHAN R. SMITH, *Archivist.*

* The Treasurer has been without clerical help on his accounts since April, 1943.

Report of the Board of Editors

Volume 33 of the Journal was slightly larger than Volume 32 of the previous year. The 12 issues contained 388 pages distributed among the sciences as follow:

Sciences	No. of papers, 1943	Pages, 1943	Percentages, 1943	No. of papers, 1942	Pages, 1942	Percentages, 1942
Biological	56	293.8	75.4	43	211.8	56.3
Physical	7	47.6	12.4	12	106.2	28.2
General	2	17.8	4.6	2	14.9	4.0
Proceedings	—	25.4	6.6	—	39.1	10.4
Obituaries	—	—	—	—	—	—
Index	1	3.4	1.0	—	4.0	1.1
	65	388.00	100.00	57	376.0	100.0

This volume includes the addresses of the retiring presidents of the Academy and of the Geological Society. It includes one of the addresses given by the three recipients of the Academy awards; the twelfth Joseph Henry lecture and an address delivered before one of the regular meetings of the Academy. Of the 65 papers presented 39, or 60 percent, were presented by members of the Academy. This represents no advance in the number of papers presented by members as compared with the two preceding years. The volume contains 51 line cuts and 12 halftones.

Volume 33 is larger by 12 pages than Volume 32 published in 1942. This small increase is a step in the right direction. The editors and others have long deplored the steady decline in number of pages published by the Journal since 1915. This year, 1943, it was not possible to do much more than arrest the decline of the past years. This unfortunate circumstance did not result so much from a lack of funds as it did to war conditions which prohibited the Journal from using more paper this year than during the previous year.

A glance at the figures showing number of articles and number of pages printed during the year shows a great disproportion of biological papers. This was true last year also, but the 1943 Journal shows a still more important decline in the number of papers and pages published under the heading of Physical Sciences. Only one paper in chemistry was published and this appeared under the heading of Geochemistry. Two papers only fall in the category of Physics. Of the Biological Sciences the largest number of papers appears under the heading of Botany (16); the next in abundance are those classified as Zoology (13). Probably no relief of this situation will occur while the war is still on, making it impossible for some time to balance the Journal better between the Physical and Biological Sciences.

The reduced budget on which the Journal has operated for two years proved adequate through use of the rigid economies instituted in 1942. It will be recalled that the Board of Editors in 1942 eliminated all free reprints and reduced amount of illustration allowed to an author to one full page of line cut or its equivalent in cost. It was also left to the discretion of the editors whether they make charges for exceptional amounts of foreign matter, tabular material or unusual type. The editors were also given authority to charge for unreasonable amounts of galley changes. During 1943 these economies were diligently applied and resulted in a comfortable balance.

In the middle of the year a modification was made in the rule that no free reprints are issued to authors. The change was made in the case of authors of obituaries. It was realized that some hardship and ill will were created by the practice of charging authors for reprints of obituaries, particularly in instances where the editorial Board had actually solicited the obituary. This situation was corrected by allowing 50 reprints free to an author of a signed obituary.

The Board of Managers appropriated to the Editors for printing, illustrating, and mailing the Journal and other items $2,800; for clerical assistance $240; for postage and incidentals $60—a total of $3,100. Of this sum the total amount of $240 was expended for clerical assistance; and postage and incidentals (binding 2 back volumes of the Journal) required $29.56. Printing and mailing the Journal cost $2,540.56, while illustrations cost $258.35. Reprints cost $387.16* making a total paid out by the Academy of $3,186.07.*

The economies discussed above resulted in charges to authors of the following items:

* These figures do not include reprints for December. Inasmuch as the December reprint bill includes no obituaries, this item will be exactly balanced by charges to authors and will not affect the final total saving.

Excess illustration (above 1 page line cut or its equivalent)	104.51
Excess alterations	22.65
Excess typesetting	32.43
Reprints	367.95*
	527.54

Deducting the $527.54 paid by authors from the grand total paid out leaves $2,658.53 net cost to the Academy. A balance of $30.44 remained in the item postage and incidentals and $141.47 in printing and mailing, making a total favorable balance of $171.91.

	Printing and mailing	*Clerical assistance*	*Postage and incidentals*	*Balance*
1943 Budget	$2800	$240	$60.00	
Paid out to Dec. 1943	$2658.53	$240	$29.56	
	141.47	—	30.44	$171.91

The Board of Editors here expresses its deep appreciation for the cooperation of Mr. PAUL H. OEHSER, whose editorial guidance makes possible the general excellence of form and composition of the JOURNAL. The senior editor also thanks his colleagues on the Board for their cheerful assistance and high quality of their work. Special thanks are due JASON R. SWALLEN who managed the JOURNAL between February and June.

G. ARTHUR COOPER.
LEWIS V. JUDSON.

[The third member of the Board, JASON R. SWALLEN, was in Brazil during the latter part of 1943.]

Report of the Custodian and Subscription Manager of Publications

Subscriptions.—No special campaign was inaugurated, owing to the unsettled conditions, for obtaining additional nonmember subscriptions. Our present subscriptions are approximately as follows:

Nonmember subscriptions in United States	100
Nonmember subscriptions in foreign countries	25
Nonmember subscriptions in enemy-controlled areas (inactive)	35
Subscriptions, Geological Society of Washington	12

Stocks of publications.—Thanks to the splendid system adopted by my predecessor, WILLIAM W. DIEHL, the first man to hold this office, the initial responsibilities and organizational work confronting the Custodian of Publications were reduced.

In 1939 the Board of Managers instructed the Custodian to set aside a specific number of volumes to be sold only as complete sets. At that time it was ordered that eight complete sets from Volume 1 to the current volume; six additional sets from Volume 11 to the current volume; and eleven additional sets from Volume 16 to the current volume should constitute the reserve sets. Since 1939 two complete sets from Volume 1 to the current number were sold. Nevertheless, many of our members have kept the Academy in mind when disposing of their own volumes and those of deceased members. As a result of these donations practically two additional sets from Volume 1 onward have been filled.

In view of the possible demand from foreign countries after the war, I have made it a policy to maintain as many complete sets as our stocks of early numbers will permit.

Inventory of stocks as of December 31, 1943.—

Reserve Sets of the JOURNAL:	
Bound Volumes 1–29 and unbound Volumes 30–33	1 set
Unbound Volumes 1–33 (Vol. 2, no. 20 missing)	7 sets
Unbound Volumes 11–33	6 sets
Unbound Volumes 16–33	11 sets
Proceedings of the Washington Academy of Sciences:	
Volumes 1–13, inclusive	50 sets

A miscellaneous series of volumes and separate numbers of the JOURNAL OF THE WASHINGTON ACADEMY OF SCIENCES are maintained for sale as back numbers. A detailed inventory of this series is attached. Odd numbers of the Proceedings of the JOURNAL together with Directories and reprints of special articles are also available.

All these volumes, including the reserve sets, except a few after Volume 22, are stored without cost in the Smithsonian Institution and the U. S. Coast and Geodetic Survey. Those few volumes after Volume 22 are stored by the George Banta Publishing Co. at Menasha, Wis.

Sales and expenditures.—During the past year approximately 150 back numbers of the JOURNAL have been sold, proceeds amounting to $72.20. An allotment of $50 was assigned to this office for 1943, of which $16.03 was spent for stamps and clerical assistance, leaving an unexpended balance of $33.97.

FRANK M. SETZLER, *Custodian and Subscription Manager of Publications.*

* Does not include $19.21 paid by Academy for reprints of obituaries.

Report of the Committee of Tellers

A total of 253 envelopes were delivered to the Committee by the Secretary. Of these, four bore no signature and two were communications to the Secretary. In the remaining 247 envelopes there were 236 ballots on an amendment to the bylaws and 240 ballots for officers and managers of the Academy.

The count of ballots on the amendment to Article I, Section 2, of the bylaws extending life membership to members of the Academy who have not been active members for 10 years upon retirement from the gainful practice of their profession because of age or disability with the option to obtain notices of meetings and the Journal at a reduced rate showed: 229 ballots for the amendment and 7 against.

The count of ballots for officers of the Academy showed the following elected:

President, Clement L. Garner
Secretary, F. G. Brickwedde
Treasurer, Howard S. Rappleye
Board of Managers to January, 1945, to complete an unexpired term, William A. Dayton.
Board of Managers to January, 1947, Henry G. Avers and Francis M. Defandorf.

W. G. Brombacher, *Chairman.*
W. D. Urry.
George R. Wait.

Submitted by F. G. Brickwedde, *Secretary.*

Obituaries

Leon Wilson Hartman was born in Downsville, N. Y., on June 18, 1876, and died in Los Angeles, Calif., on August 27, 1943. During his adult life he was primarily interested in teaching physics. However, he always found time to carry on some research and on several occasions spent a few months or even a year in research work.

Dr. Hartman received his bachelor's degree from Cornell University in 1898 and his master's degree a year later. He continued his graduate work at Cornell for two years, then taught at Kansas State College for a year. He received the Frazier fellowship of the University of Pennsylvania in 1902. This university conferred on him the degree of doctor of philosophy in 1903. Receiving then the Tyndale fellowship, he spent a year at postdoctorship study at Göttingen.

Returning from Germany he started his long career as a teacher of physics; first at Cornell, then at the University of Utah, and finally for 30 years as head of the physics department of the University of Nevada, of which university he was president during the last five years of his life.

When Dr. Hartman was at Göttingen he became interested in research on the Nernst glower, then one of the most efficient devices for converting electrical energy into light. This occupied his attention for a number of years. Later he became interested in researches involving electrical measurements. At the National Bureau of Standards he collaborated in a method of measuring inductance by using a pulsating current.

Dr. Hartman's devotion to teaching culminated in his election to the presidency of the University of Nevada. During the five years of his incumbency he worked unceasingly for its advancement. While on his first vacation for several years, he was stricken with a fatal cerebral hemorrhage.

Dr. Hartman was a member of many scientific and professional societies, among them the Washington Academy of Sciences. He is survived by his widow, Dr. Edith Kast Hartman, and by four children.

H. L. Curtis.

Elmer Darwin Ball, whose active career was terminated in February, 1938, by a cerebral hemorrhage, died on October 5, 1943, in Pasadena, Calif., at the age of 73. Dr. Ball was born in Athens, Vt., in 1870, but his family soon after removed to Iowa, which thus became essentially his home state. To Mildred R. Norvell, who survives him, he was married in 1899. Dr. Carlton R. Ball, of Washington, D. C., is a brother.

Iowa gave him his public-school and college education as well as his early teaching experience. He earned the B.S. and M.S. degrees at Iowa State College in 1895 and 1898, and in these early years he taught in the public schools of Iowa and in Albion Seminary, where he was assistant principal for one year. In his alma mater he first served in a scientific teach-

ing capacity as assistant in zoology and entomology, and beginning in 1897 he served four years in a similar capacity at Colorado Agricultural College.

A professorship in the Utah Agricultural College next claimed him, and during his term of service there he earned the Ph.D. degree, granted by Ohio State in 1907, under Prof. Herbert Osborn. From this contact resulted his outstanding life work on leafhoppers and related families of insects. The same year that he received his doctorate, Dr. Ball was elevated to the deanship of the Utah Agricultural College and to directorship of the Agricultural Experiment Station. The writer's 35-year friendship with him dates from this period.

Dr. Ball held membership in a number of the usual professional organizations, including entomological societies and the Ecological Society of America, in addition to membership in the Washington Academy of Sciences and the science academies of five states.

In 1916 Dr. Ball accepted the position of state entomologist of Wisconsin, only to return two years later to Iowa State College as head of the Department of Zoology and Entomology, a position that includes the duties of state entomologist of Iowa. From this position he was granted leave for two years to serve as Assistant Secretary of Agriculture under Secretaries Meredith and Wallace. Giving up his position in Iowa, he served from 1921 to 1925 as director of scientific work in the U. S. Department of Agriculture, where he worked for better salaries for the department's scientific workers.

Dr. Ball served with the Florida State Plant Board, in charge of important celery insect investigations, from 1925 to 1928. The publication on the celery leaf tier by Ball and his coworkers is outstanding in its recognition of the ecological side of the problem and relates the damage done by the insect very specifically to seasonal conditions basically dependent on weather.

In October, 1928, he accepted the deanship of the College of Agriculture, becoming at the same time director of the Agricultural Experiment Station, of the University of Arizona. He transferred in 1931 to teaching and research as professor of zoology and as experiment station entomologist, the position occupied when illness overcame him.

Dr. Ball was an indefatigable investigator, not only in his official positions, but in his private time as well. Officially, he pioneered in codling-moth control, did genetics work in poultry breeding, and was definitely a pioneer in the recognition of transmission of plant diseases, now known to be virus diseases, by insects—a natural corollary of his familiarity with leafhoppers and related sap-sucking insects, to which he so assiduously devoted his every possible hour and vacation. He first recognized the first- and third-discovered instances of insect-transmitted plant diseases—curly top of sugar beets, and tipburn of potato. The Ball collection of leafhoppers and related families is now a part of the National Museum collections.

Dr. Ball with students was enthusiastic and helpful; with coworkers a cheerful and loyal friend.

CHARLES T. VORHIES.

FRANK LEVERETT, a member of this ACADEMY for 30 years, known for years as one of the leading glacial geologists in the United States, died at Ann Arbor, Mich., on November 15, 1943. He was born on March 10, 1859, at Denmark, Iowa, the son of Ebenezer and Rowena (Houston) Leverett. From 1880 to 1883 he was an instructor in natural science at Denmark Academy, Iowa, and on completing studies at Iowa State College he received the B.S. degree in 1886. At times (1909–1929) during his residence at Ann Arbor, Leverett delivered lectures on glacial geology at the University of Michigan, and in 1930 this institution conferred on him the honorary degree of doctor of science.

In 1886–1890 he served on the U. S. Geological Survey as field assistant under the direction of Dr. Thomas C. Chamberlin, geologist in charge of the Glacial Division. Thus began Leverett's official study of the glacial and associated deposits in the United States. In 1890 he became an assistant geologist with the U. S. Geological Survey; he was geologist from 1901 to 1928 and senior geologist from July 1, 1928, to March 1929, when he was retired at the age of 70 years. Dr. Chamberlin continued more or less actively in charge of the glacial studies for the Federal Survey, both while he was president at the University of Wisconsin beginning in 1887 and also after he became head professor

of geology at the University of Chicago in 1892, until the year 1904, when he severed his connections with the U. S. Geological Survey. During all this time the two men were closely associated by correspondence and conferences, during extensive field studies of the glacial and associated deposits. This association continued much the same through the later years until Chamberlin's death on November 15, 1928.

The extent of the area covered by Leverett's field studies and mapping was very notable indeed, and from these studies there came a large number of scientific papers. Several of his more comprehensive publications were issued by the U. S. Geological Survey. In Monograph 38, *The Illinois glacial lobe* (published in 1899), are described the great Illinoian drift sheet and its relation and later glacial deposits. In this work was included the classification of all the glacial and interglacial deposits of the Upper Mississippi Valley, as developed very largely by Chamberlin and Leverett. This, with later modifications, is still the standard classification of North American glacial geology.

From Illinois Leverett's field work was extended eastward over Indiana, southern Michigan, the western part of New York, and the northwest part of Pennsylvania. The results of this study were published in Monograph 41, *Glacial formations and drainage features of the Erie and Ohio Basin.* In this were also shown the relations of the remarkable abandoned beaches bordering the Great Lakes. These were formed when the outlets of the several basins were blocked by oscillating fronts of the great glacial lobes and were deformed by northeasterly differential uplifts as melting removed the weight of the vast accumulations of ice. Frank B. Taylor was for many years associated with Mr. Leverett in the mapping and study of the abandoned beaches, and when the field studies were extended northward over the lower and upper peninsulas of Michigan they became joint authors of Monograph 53, *Pleistocene of Indiana and Michigan and history of the Great Lakes*, published in 1915.

When the mapping was continued north and west through northern Michigan and Wisconsin and into northeastern Minnesota, a shorter work by Leverett, *Moraines and shore lines of the Lake Superior Basin* (Professional Paper 154) was published by the Survey in 1929. Following this Leverett's mapping proceeded throughout Minnesota and into adjacent parts of Iowa and the Dakotas. In this survey Leverett revised the earlier mapping by Warren Upham and delineated on a large map the succession of alternating moraines and glacial outwash plains and the abandoned beaches of Glacial Lake Agassiz. From this work came his Professional Paper 161, *Quaternary geology of Minnesota*, issued by the Federal Survey in 1932. To the preparation of this report contributions were made by F. W. Sardeson, who also assisted in the field mapping. Later Leverett studied the relations along the southern border of the glacial drift through much of the distance between northeastern Kansas and the Atlantic coastline in New Jersey.

Most of the studies were made by Mr. Leverett while on the staff of the U. S. Geological Survey; work on his manuscripts was mostly done at his home, which was for years in Ann Arbor, Mich. At intervals he was released from his regular work to make other investigations, some of these for state geological surveys. In 1908 he went to Europe to make comparative studies on the several drift sheets there and he set up a tentative correlation between the glacial deposits of Europe and the United States in a paper *Comparison of North American and European Glacial Deposits*, published in Zeitschrift für Gletscherkunde **4**: 1910.

In 1887 Mr. Leverett married Frances E. Gibson, who died in 1892. In 1895 Dorothy C. Park became his wife and now survives him.

William C. Alden.

To coordinate the various branches of science, to integrate science as a whole with other lines of human activity, and to quicken an appreciation of science on the part of the general public—these were the impelling interests in the life of James McKeen Cattell[1] (May 25, 1860–January 20, 1944), a member of this Academy. As a young and brilliant psychologist he foresaw more clearly than any of his contemporaries that science, in order to progress, must break away from the cloistered tradition and compartmentalization of the academic laboratories; that in order to be of real benefit to the people it must be attuned

[1] For details of Dr. Cattell's life and activities see Science 99, No. 2565, Feb. 25, 1944, and Who's Who in America.

with human affairs in general; and that in order to gain the necessary support for further development it must gain the confidence of the public at large.

Only in his later years did these objectives become clear to his colleagues. In his earlier years progress was difficult and slow. Every opportunity that appeared was seized and exploited. At first his endeavors were more or less disconnected and haphazard. Quite naturally his interest for some time was centered largely on psychology, though this never obscured his broader vision; later his expanding interests covered all lines of science.

The media through which he worked were the numerous publications that he edited, several of which he himself had founded, and the American Association for the Advancement of Science in which he was a dominant force for 50 years, and which owes its present organization and prestige largely, if not mainly, to his efforts. His influence in stimulating and organizing the scientific spirit of America was much greater than appears on the surface. As editor of various scientific journals he was interested in bringing out facts and in stimulating discussion. He solicited contributions from those whom he thought had something worth while to say, and many significant papers were published in his journals which, except for his stimulation, would never have appeared. Scrupulously fair and honest in his dealings with contributors, he interpreted his duties as editor with unusual liberality, and not infrequently there appeared in his journals papers expressing ideas with which he did not agree.

During the first world war the improvement and extensive use of the airplane and the radio, and other implements and devices, quickened public interest in science. Dr. Cattell was one of a small group who felt that science had now outgrown its orthodox academic confines and had secured the serious attention of an important sector of the lay public. It had therefore become desirable that the general public be kept informed through the press of progress in the various branches of science. Upon the establishment of Science Service in 1921, Dr. Cattell was chosen one of the members of the Board of Trustees, and served continuously upon it until his death, most of the time as a member of the Executive Committee, and for nine years as President.

Coincidentally with the establishment of Science Service the *New York Times* and the *Cleveland Press* each detailed one of their ablest writers as science editor. Their example was soon followed by other newspapers and the large press associations. Although these independent science editors were direct competitors of Science Service, Dr. Cattell showed no favoritism, but assisted and encouraged all serious attempts to report science accurately. When the National Association of Science Writers was organized in April, 1934, the science editors showed their appreciation of his efforts in their behalf by electing him an honorary member.

Personally Dr. Cattell was a man of distinctive and forceful personality, courageous, with strong convictions, intense in an argument—indeed on occasion almost violent. Motivated by the highest principles, and always honest, if he thought, on reflection, that he had done an injustice he sought out his adversary and apologized to him. But basically his was an unusually gentle and kindly nature. He never felt that he really knew anyone unless he knew his whole family, especially the children. And although many of his colleagues stood very much in awe of him, small children took to him at once. He was always very human. In his rare periods of relaxation, for instance when attending parties given by the science writers, he joined enthusiastically in the merrymaking, becoming a boy again.

Dr. Cattell will long be remembered for his personal contributions to the study of psychology and to the improvement of education; but his outstanding contribution was the part he played in the awakening of a feeling of social responsibility on the part of our scientific people, and of an awareness of the importance of science on the part of the general public.

AUSTIN H. CLARK.

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JOURNAL
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VOLUME 34 JULY 15, 1944 No. 7

BOTANY.—*An account of sixteenth-century agriculture on the Mexican Plateau.*[1]
HOWARD S. REED, University of California.

The successful development of agriculture and allied arts among the peoples of the central plateau of Mexico was quickly recognized by the Spaniards who carried the conquering arms and banners of Charles V into that new world. In spite of the conquest and the overthrow of pre-Cortesian kingdoms, the cultural elements of the ancient tribes continue to influence the practical lives of most modern Mexicans. The food plants of the native races have an unfailing interest for any enquiring mind. Moreover, the character of the post-Conquest colonization was determined in large measure by the cultural background of the native races, no less than by climatic and geographic conditions of the country.

The memoir of Tezcuco,[2] by Juan Bautista Pomar, written in 1582 has been reprinted recently and relates some matters of prime importance concerning the agriculture of that kingdom. The author was a mestizo, a native of Tezcuco, son of a Spaniard, and grandson of Nezahualpitzintli, king of Tezcuco. His mother was the daughter of the said king and of an Indian slave.

The account that I shall give here will be concerned mainly with the cultivation and utilization of food plants drawn from the reprint of Pomar's treatise. His statements concerning the introduction of cultigens from other districts have proved to be highly significant.

Pomar wrote intelligently of the agricultural and economic systems of the people of Mexico in his day. He was another historian and panegyrist of Tezcuco, inferior certainly to Ixtlilxochitl, but older and more temperate. He was always in accord with what was Tezcucan, did not invent things of which he was ignorant, and wrote without exaggeration. He added certain details unnoted by Ixtlilxochitl, and untangled the twisted statements of other historians who described the kingdom and its people. He chose to leave the discussion of medicinal plants to Hernândez, who came to Mexico in 1570.

If the assumption be correct that the Tezcucan population was composed of peoples of diverse origins who entered and settled in its borders, and where civilization was fostered by wise rulers, it is evident that any authentic record of its arts and industries is of major importance.

Tezcuco, the capital city, when at the apex of its development, had a population of 300,000 people who necessarily depended for their subsistence upon the labors of a larger number of rural subjects.

The kingdom of Tezcuco was situated east of the lake of the same name. The land sloped upward from the lake to the foot of the high mountains to the eastward and was traversed by numerous short rivers from which water was diverted by canals and ditches. Pomar described their water resources as follows:

> Large and voluminous rivers do not occur in this city or near it, because the arroyos of water which run to it are hardly able to reach the lake in the dry season. Morover, there was a necessity to unite and reduce into one many springs from their true sources, leading them from their courses and natural channels into conduits and canals which Nezahualcoyotzin and Nezahualpitzintli made, not solely for drinking water, but also for irrigating their orchards, gardens, and other property, and houses of pleasure. Now they also serve

[1] Received March 18, 1944.

[2] POMAR, J. B. *Relaciones de Tezcoco, 1582.* (Reprint, Salvador Chavez Hayhoe, Mexico, 1941).

to irrigate plantings of maize and wheat and on them the Spaniards have built mills for grinding and cloth making.

The water systems were not kept in repair after the subjugation of the country by the Spaniards because of the disruption of the kingdom.

Pomar's descriptions of agricultural plants are valuable additions to those given in a piece of picture writing made in 1530 by another Tezcucan scribe under the direction of a Spanish teacher which depicted plants supposedly typical of Cempoallan and other cities tributary to the kingdom of Aculhuacan.[3,4] The lists of agricultural plants differ somewhat, since Tezcuco lay at a higher altitude than Cempoallan.

The list of important, indigenous fruit crops shows that horticulture had reached an advanced stage of development among the Tezcucans. Pomar wrote:

The cultivated lands give good crops of fine cherries, of excellent flavor, taste, and a reasonable livelihood. There are apple trees which give a fruit, yellow with a red blush, equal in size and flavor to that of Castille which we call San Juan. Some of these are better than others according to the culture which they give to the trees or to the quality of the soil in which they grow. The Indians dry apples and cherries and keep them for luxuries in winter. Apples of Castille, pears, and quinces may easily be grafted upon these apple trees. They have also blackberries. The avocados and white zapotes which they call "Sleepy Heads" are cultivated in this city in sheltered and warm locations, yet they are very small and inferior because they belong in the hot country.

He commented also upon oranges, peaches, pomegranates, and other European fruits cultivated in Tezcuco at the time he wrote.

The frequency with which the cactus *Opuntia tuna* Mill. was mentioned by Pomar and other early writers indicates that then, as now, it was an important food plant. The fruits were eaten either fresh or cooked. The sap pressed from the fleshy joints was administered to persons suffering from illnesses due to the heat. Practically every part of the plant had some particular use. He stated specifically that the plant was cultivated and described several of the principal varieties.

The agave was cultivated in pre-Columbian times, yielding many products of necessity and convenience. The saccharine sap was fermented to produce *pulque* or was evaporated to make a syrup which was an equivalent for sugar in their dietary. The leaves were a source of fiber, and of a tough paper. The people used the hot sap from agave leaves as a vulnary, an application not mentioned by other writers on pre-Columbian botany. Pomar said: "One of their principal plants is a kind of maguey which they call *Coxamalometl* with which they heal all sorts of wounds. They roast the fleshy leaves in hot embers and wash the wound with the hot sap from them and allay the convulsion (spasmo) by placing the leaf on the wound. So marvellous are its effects that they make cures which the medicos regard as miraculous."

Wine was made by fermenting these saps in wide-mouthed earthen jars which were kept loosely covered until the fermentation was finished. Wines from various sorts of agaves had their particular qualities, the inferior sorts being used only for cooking.

Maize, the all-important crop which furnished the principal supply of their carbohydrate food, was briefly mentioned by Pomar although omitted entirely by the unknown writer of the chronicle of Cempoallan.[3] Pomar gave no description of their methods of cultivation, to our great regret. Possibly he thought they were so well known as to require no mention in his communication to the king of Spain. Concerning other grains he wrote as follows: "The native grains, seeds, and culinary vegetables which have served, and still serve, the natives are first maize, then beans of different sorts and colors which, cooked with pepper, are the sustenance of the ordinary people, then the *chia* or sage (*Salvia* sp.) which is a small seed somewhat larger than the mustard, . . . of which the natives make a drink after roasting, grinding, and boiling it with water."

[3] Reed, H. S. *Ixtlilxochitl II and Cempoallan: A preliminary study of a Mexican picture-chronicle.* Hispanic Amer. Hist. Rev. **18**: 66–75. 1938.

[4] Gomez de Orozco, Federico. *El codice de San Antonio Techialoyan. VI. "Codice de Cempoalla."* Anal. Mus. Nac. Arqueol., Hist., y Etnogr. (4)**8**: 311–332. 1933.

Huauhtli is the name of an important species of *Chenopodium* that was used as food by the ancient as well as the modern Mexicans. In his *Relaciones de Tezcoco* Pomar wrote: "Huauhtli is a seed like rape and of the same color, except it is a little flattened like lentils. After it is ground and kneaded they make firm loaves in maize leaves (husks?) which are cooked in ollas, or they make them into tortillas which are cooked on a comal. . . . They have michhuauhtli which is a smaller white seed of which they make loaves of bread like those of huauhtli and a beverage of the roasted and ground seeds dissolved in syrup." Emmart[5] interpreted michhuauhtli as "fish grain." The Aztecs made a poultice from its seeds for the treatment of siriasis, an inflammation of infants.

Pomar's mention of the uses of this plant was undoubtedly the first in any European language. Hernández[6] later described a medicinal plant of Mexico and gave it a name which suggests similarity but not identity with huauhtli. Thus: "We find in this New Spain many kinds of Atriplex agrestis which are universally called Hoautli or Hoahoautli and get great care in their gardens and orchards, such are Tlapal hoaquilitl or Tlapalhoauhtli." His description of the thick fibrous roots, red stem, and reddish flowers, however, suggests *Amaranthus* rather than *Chenopodium.*

Huauhtli was a cultivated plant, possibly not a native of Mexico, but modified by centuries of cultivation and selection. Its exact identity is not well established. From Mrs. Zelia Nuttall Safford obtained material which he described as a new species, *Chenopodium nuttalliae,*[7] stating that it has been cultivated from time immemorial by the Mexicans and that it is now unknown in the wild state. He said that the name Uauhtli, or Huauhtli, was applied by the Aztecs not only to the seeds, but to the plants as well; but when the plants were cooked for greens they were called Huauquilitl. Other botanists[8] have attempted to identify this plant as *C. quinoa,* which has been cultivated as a food plant by certain South American Indians since prehistoric times.[9]

I have had the opportunity of examining specimens lent by the Gray Herbarium of Harvard University which were collected by Dugès at Guanajuato. They are *Chenopodium album,* yet were said to be cultivated plants. The leaves are oval and somewhat decurrent; petioles as long as the laminae; seed-bearing heads quite compact. The label, apparently written by Dugès, contains the following important information: "Quelite cultivé. Sous le nom de Cuauzontle ou Cuauxoncle on mange les extremites fleuries, frites et envelopées d'oeuf. C'est un bien pauvre legume."

Another sheet of plants labeled "Quelite sauvage" which was also designated *C. album* by Dugès, contained smaller specimens whose slender stems bore loose heads, resembling plants often grown on barren soils.

The systematic relationships of *C. nuttalliae* are somewhat indefinite. In response to my inquiry, Dr. I. M. Johnston[10] wrote that the species seems to be very distinct from other undoubtedly native Mexican species of the genus, and concluded that it may well be a cultivated plant. There is every reason for distinguishing the plant called huauhtli from *C. album,* which is of European origin and would not therefore have a well-recognized Aztec name. Specimens of *C. nuttalliae* lent by the U. S. National Herbarium have no resemblance to other well-known North American species.

Dr. C. O. Sauer, of the University of California, has reported[11] that he saw a plant called huauhtli in Sinaloa. It therefore seems possible that the name may be applied to other edible species of *Chenopodium* in diverse parts of modern Mexico.

[5] EMMART, EMILY W. *The Badianus manuscript.* Baltimore, 1940.

[6] HERNÁNDEZ, FRANCISCO. *Rerum medicarum,* Liber VIII, 11, p. 269. Roma, 1651.

[7] SAFFORD, W. E. *Chenopodium nuttalliae, a food plant of the Aztecs.* JOURN. WASHINGTON ACAD. SCI. 8: 521–527. 1918.

[8] AELLEN, P. *Beitrag zur Systematik der Chenopodium-Arten Amerikas.* Fedde Repert. Sp. Nov. **26**: 124. 1929.

[9] PARODI, L. *Relaciones de la agricultura prehispanica.* Anal. Acad. Nac. Agron. Vet. Buenos Aires. **1**: 115–167. 1935.

[10] JOHNSTON, I. M. Personal communication, 1943.

[11] SAUER, C. O. Personal communication, 1943.

There is evidence, therefore, that the plant which the Tezcucans called huauhtli had been brought into cultivation in pre-Colombian times and that the name may have been conferred also on *C. album* when it spread into Mexico from the Old World.

Although the Spaniards had introduced European pot-herbs, the natives preferred plants they had domesticated, some of which had been brought to Tezcuco from other localities.

Gourd fruits were cooked and eaten, and their seeds were added to many sorts of stews, to which they were said to impart an agreeable quality on account of their oil content. Pomar said that their gourds had the form and color of melons of Castille, though their rind was firmer. The chayote which bore fruits throughout the year was highly prized because of its flavor and keeping qualities. He wrote further of other vegetables:

> Tomatoes (and miltomatl) serve as spice with the peppers from which they make sauces and appetizers. These are different from any Spanish fruit. They will not be discussed further because they are well-known and they grow and yield in Spain . . . They have wild amaranth, watercress, tender onions, and purslane which they salt at the proper season. Peppers of many sorts and colors are eaten in all their food, fresh and dried, without which no food is acceptable to them.

The culture of European cereals on the estates of the Spaniards received the following comment from Pomar:

> Wheat and barley yield wonderfully on the farms and estates of the Spaniards, but very few Indians have space for them or for their proper sowing, being ordinarily occupied in the service of the Spaniards. They have harvested in Tezcuco and its surroundings as much as ten thousand fanegas of wheat, but very little barley, except what suffices for home use, because those who plant and harvest it do not sell it as they do wheat. Neither do they produce silk, although it would be possible for there are mulberry trees for feeding the worms. Formerly it was produced by D. Antonio Tlalhuitolzin, cacique and governor of the city, who was the son of Nezahualpitzintli.

He wrote briefly about tobacco, but did not state that it was cultivated in Tezcuco. The species which they knew was undoubtedly *Nicotiana rustica*. The name by which they knew it was Piçietl—the little fragrant tobacco—and it will appear from the following paragraph that tobacco was regarded as a medicinal plant by the majority of the Tezcucans:

> The herb which they call piçietl, which is said to be the same as that called henbane in Spain, is useful for sleep and for deadening the flesh and making the hard-worked body insensitive to fatigue. They take the ground dried leaves, wrap them around a little lime, and put a quantity such as would fill a hazelnut into the mouth between the lips and the gums when they go to sleep or to work. However, few of the Indians who are educated with Spaniards use it, neither the urban and polite gentry, only rustics and laborers. They also employ this herb for smoking in little reed tubes wrapped with liquidambar. They light the tips of the packed tubes and draw at the other end with the result, it is said, that they dry out the head and purge the rheum of the mouth. This is already admitted by the Spaniards who suffer these infirmities and use it as their remedy with benefit. They use it also for quotidian, tertian, and quartan fevers taking it as a suppository which purges them. Likewise the toasted leaves placed on the abdomen, when there is pain, cures them.

Omitting several other plants which Pomar mentioned as remedies, we may pause to read his lines about a plant known as ololiuhqui, since Hernández[12] also commented upon it. The name meant "Plant of the Serpents" and was synonymous with coaxihuitl.

"Ololiuhqui which is also brought from the hot country has a seed. When ground and made into a dough, it reduces swellings and drives away the pain. When ground and steeped in water and drank, it drives away weariness of the body because it causes sweating." Hernández said that the plant had cordate leaves and white flowers. His description and figure suggest that it might be a species of *Convolvulus*, but he said it had a rather long, rounded seed like coriander, hence the reference to serpents. Ramirez and Alcocer[13] identified the plant as *Ipomoea sidaefolia* Chois., and Safford noted (unpublished memorandum) that it grew in the Department of Monte Christo, Campeche, Yucatán.

His reference to another vegetable product is a bit difficult to interpret:

[12] Hernández, Francisco. *Rerum medicarum* Liber V, 14, p. 145. Roma, 1651.

[13] Ramirez, J., y Alcocer, G. V. *Sinonimia vulgar y cientifica de las plantas Mexicanas.* Mexico, 1902.

There is a little grana, not within the city but in the highlands like those between the city and the mountain and range of Tlaloc, which is somewhat more temperate and yet here the Indians give little to the city. Indeed, it may be that they have no time to attend to it because of their ordinary occupation which demands personal services to such an extent that they could not have time to harvest wheat and barley and to produce silk and grana.

Grana may mean the seed of a plant, but it can also mean scarlet grain, or cochineal, which the ancient Mexicans used so extensively for dyeing. According to Ximenez, the care and rearing of the coccids from which the dye was obtained was a recognized industry.

There is a sapient remark about the use of simples which must be mentioned before these notes are terminated. Those who have often perused the long dissertations about the real *and* fancied medicinal worth of many plants written by natives and Europeans in the sixteenth century will enjoy this soft sarcasm from Pomar's pen: "They have many roots for purging all sorts of humors and very good in the opinion of those who use them, except that they don't know how to apply them and they cure more or less by chance."

A study of his account of the botanical and agricultural topics relating to Texcucan civilization impresses one with his accurate, first-hand information on the subject, which should guide those who would search for plants worthy of wider utilization in our time.

ETHNOLOGY.—*Algonkian ethnohistory of the Carolina Sound.* MAURICE A. MOOK, American University.

(*Continued from page 194.*)

In some respects the best-known Carolina Algonkian group, at least the one with which the Roanoke colonists had the most numerous contacts, was the so-called Secotan. This tribe's domain extended from Albemarle Sound to lower Pamlico River and from Roanoke Island to the west-central region of present Beaufort County. Western Beaufort County and the river region above the present city of Washington, as will be seen, seem to have belonged to another tribe (the Poumouik). The northeastern section of the peninsula between the Pamlico and Neuse Rivers was also a part of Secotan territory. Secotan distribution thus included the present counties of Washington, Tyrrell, Dare, and Hyde, the greater part of Beaufort, and the northern part of Pamlico. The native inhabitants of the offshore islands were geographically, and perhaps also culturally and politically, closer to the Secotan than to any other Algonkian group.

Because of proximity to Roanoke the English colonists had closer contacts with the Secotan Indians than with any other tribe of the Carolina coast. Barlow's Wingandacoa is usually identified with Secotan (106), and most of the Indians whom he mentioned by name—Wingina, the chief, Granganimo, his brother, Wanchese and Manteo, the natives whom he took to England with him—were inhabitants of this area. Other persons and places referred to in his narrative are known by the relation of Secotan informants. Hariot stared that most of his ethnological information pertained particularly to the coastal area in the vicinity of Roanoke, and White's pictures of Indian scenes and subjects dealt largely with the towns of the Secotan tribe. He claimed that there were minor differences in native customs between towns in this territory, but such differences are to be expected among towns spread over an area as large as the one above indicated.

There is no information on the size of this group in 1586 (107), but that it was not the largest and strongest tribe of the region may be deduced from the facts of aboriginal history that are recorded in the narratives. For example, when Pemisapan (Wingina) planned his conspiracy against the English he called upon the northern tribes (Weapemeoc, Chowanoc, and Moratoc) for help and seems to have been but indifferently supported by the mass of his own people. Lane stated that the Chowanoc were the

strongest tribe of the area, and Hariot reported that native towns on the Secotan coast were small and not numerous. When Barlow visited Roanoke Island the native town on it had but nine houses, and White's drawings of the towns of Pomeiock and Secotan show them to have been small settlements (108). Yet the territory of the Secotan was greater in area than that of any other Algonkian group of the Carolina seaboard.

Eight Secotan villages are known by name, the locations of some of which can be determined more accurately than is possible for most of the settlements previously considered. There were two villages in northern Secotan territory south of Albemarle Sound, two in the eastern area on Pamlico Sound, and four in the southern section west of Mattamuskeet Lake. It is possible to locate the first four of these more accurately than the others, in spite of the fact that there are several accounts of the colonists' southern exploration, because White's (and De Bry's) map is geographically more accurate for the northern than for the southern area. The reason for our better knowledge of the native geography of the northern area is that the English "new Fort in Virginia" was established at the northern end of Roanoke Island (109) and that in their explorations by water the colonists usually sailed northward into Albemarle, rather than southwestward into Pamlico Sound. The Croatoan Indians lived south of Roanoke Island, and at least one historian has suggested that their consistent friendliness toward the English was due to their more distant southern location, in an area farther removed from and less molested by the English and therefore less threatened by the prospect of dispossession (110).

Grenville's relation of the Second Voyage (111), as well as Lane's *Account of the particularities of the imployments of the English men left in Virginia,* gives an account of the colonists' first exploration to the mainland after arriving in America. The towns visited were Pomeiok, Acquascogoc, and Secotan, and this was the order of their location from east to west. The voyage was made from the island of Wococon (Ocracoke); the ships sailed westward to the mainland (Hyde and Beaufort Counties), entered the Pamlico River, and then returned to Wococon. The towns can be located as follows:

White's map locates Pomeyoc between Lake Paquippe (Mattamuskeet) and Pamlico Sound, and the text accompanying White's drawing of "A Chiefe Herowans wife of Pomeoc" (112) states that "about 20 miles from the Iland [Roanoke], neere the lake of Paquippe, ther is another towne called Pomeioock hard by the sea." White's map shows the town on the bank of the lake rather than on the shore of the Sound, but that it was located on the Sound is indicated by Barlow's reference to "the great River called Occam (Pamlico Sound) . . . on which standeth a towne called Pomeiock" (113). De Bry's map places Pomeiock between Lake Paquuyp and the Sound, and Smith's map is again but a copy of De Bry's in this location. The site of the town on a modern map could be either Gibbs Point or the northern shore of Wyesocking Bay, probably the former. Both Mooney and Hawks placed it at the mouth of Gibbs Creek, at or near the present town of Engelhard in eastern Hyde County (114). The town was drawn by White and is represented as a small, circular, palisaded village of 18 houses (115). The Secotan town of Pomeioc is not to be confused with the tribe of Pomouik, which was also Algonkian and which bordered Secotan territory to the west and southwest.

On White's map Aquascogoc is shown west of Mattamuskeet Lake on a body of water that is apparently meant to represent modern Pungo River. De Bry's map shows a similar location. The Indian town was probably situated at or near modern Belhaven, in eastern Beaufort County. Mooney believed it to have been on the east bank of the river and gave it a location in the vicinity of the present towns of Scranton and Makelyville, in western Hyde County (116). Hawks decided that Aquascogoc was near the mouth of the Neuse River, "possibly somewhere about Broad Creek, perhaps not so low down," but he was led into error by confusing the tribe of Pomouik with the town of Pomeioc (117). Before the English had been in Carolina three weeks they burned the town and destroyed the corn

fields of Aquascogoc because one of its inhabitants had stolen a silver cup (118). Thus began that enmity in the natives that led them to refuse to trade with the English, thereby depriving the colonists of food and contributing toward their decision to abandon the colony when Drake appeared with his ships in the spring of the next year.

Weapemeoc, Chowanoc, and Moratoc were not only tribal names but also the names of towns within their territories, and the same was true of Secotan. These towns were the residences of the tribal chiefs and therefore the political centers of the tribes. Secotan differed from the three northern tribes, however, in not having its principal town in the geographical center of tribal territory. According to White's map and Barlow's and Lane's accounts, the town of Secotan was in the southern part of the territory of this tribe. Lane placed it at "the uttermost place to the Southward of any discovery" and estimated that it was "fourscore miles distant from Roanok." Barlow wrote that "Towards the Southwest foure dayes journey [from Roanoke] is situate a towne called Sequotan, which is the Southernmost towne of Wingandacoa, neere unto which . . . [is] an out Island, unhabited, called Wocokon" (119). The eastern shore of the peninsula between the Pamlico and Neuse Rivers is approximately 80 miles from Roanoke Island and is also near the island of Ocracoke or Wococon (120). White's map is improperly oriented south of the Pungo–Pamlico River region, but when corrected for the confusion in directions his towns of Secotan and Secotaoc seem to be on the south bank of Pamlico River. The former is placed about halfway up the estuary, probably east of present Bonnerton in Beaufort County, while Secotaoc is put east of Secotan in the region of Hobuchen and Mesic in northeastern Pamlico County. Secotan's site was on the south bank of the Pamlico, apparently between Durham and South Creeks, while Secotaoc may have been on the north shore of Bay River. De Bry, however, placed Secota on the north bank of a river apparently meant for the Pamlico, and put Sectuoc on the south bank. Mooney, who used De Bry's map rather than White's, accordingly located Secotan "on the north bank of Pamlico river, in the present Beaufort county" (121). Hawks relied on the narratives rather than the maps in attempting to locate Secotan, and not realizing that there were two towns involved, could not decide whether to place Secotan "somewhere near . . . Bay river" or "at the mouth of South Creek on Pamlico river, a half mile above Indian Island" (122). As a matter of fact, Hawks's alternative locations for the town of the narratives approximately correctly locate the two towns of the early maps. It is an interesting fact that whereas Secotan is one of the most frequently mentioned Indian villages in the Roanoke narratives, it is also one of the most difficult to locate specifically. This is due, of course, to the geographically indefinite references of the relations, plus the failure of White's map in this respect for the southern Secotan settlements.

In addition to Secota and Sectuoc, De Bry's map shows a town named Cotan on a stream flowing into Pamlico River from the north. The name does not appear on White's map, nor is it mentioned in the relations. Mooney identified it as "an Algonkian village in 1585 about Ransomville, Beaufort county" (123). Mooney based his location upon Smith's map; from De Bry's it would seem more likely that Cotan was situated at or near the historic town of Bath.

The relations mention but two towns in the northern part of Secotan territory, but White's map shows three and De Bry's map shows four. These were Roanoak on the island by that name, Dasamonquepeuc on the western shore of Croatan Sound, and west of Dasamonquepeuc and south of Albemarle Sound the two towns of Tramasquecoc and Mecopen. Mecopen is absent from White's map, but on De Bry's it is placed on the east bank of a stream flowing into the sound a short distance east of the mouth of Roanoke River. Mooney accordingly located the village south of the sound, near the Roanoke (124). The stream shown on the map, however, is clearly not a tributary of the Roanoke. It may have been meant for Scuppernong River, in which case the native town would have been in either eastern Washington or western Tyrrell

County. It is shown on the map as somewhat inland from the sound, which may account for Lane's failure to mention it in his accounts of the trips made in exploration of the Chowan and Roanoke Rivers. It was apparently a small village; at any rate, Barlow had not heard of it in 1584.

White's map shows the town of Tramaskecooc at the head of a stream that, to judge from its size and location, was meant to represent Alligator River. Smith's map has Tamasqueack and De Bry's has Tramasquecoock on the west bank of the river. All maps show the town on the upper course of the stream. Gerard etymologized the name of the town as "people of the white-cedar swamps" (125)—a name ecologically appropriate for inhabitants of this region.

The native village of Roanoke, situated on the northern shore of Roanoke Island, was the first one visited by Englishmen in the New World and is the only one that is specifically described in the relations of the colony. Barlow described it as a small village of nine houses fortified with a palisade of sharp posts (126). It was the residence of Granganimo, a brother of the chief of the Secotan tribe, while Wingina, the chief, seems to have lived at both Roanoak and Dasamonquepeuc. The latter was a village on the mainland across the sound from Roanoke. White spoke of Roanoke as "the Island directly over against Dasamongwepeuk," and Lane referred to "Dasamonquepeio in the maine, within two leagues over against" the English settlement on the island (127). That Wingina lived at either Roanoak or Dasamonquepeuc is indicated by Lane's statements that "the King . . . sow[ed] his ground, not onely in the Iland, but also at Dasamonquepeio" and that "Pemisapan [Wingina] went of purpose to Dasamonquepeio . . . to see his grounds there broken up and sowed for a second crop" (128).

Shortly after the colonists built their settlement on the island, the native village and the entire island seem to have been abandoned by the Indian inhabitants. This was done probably after the death of Granganimo and his father, Ensenore, both of whom were friendly to the English. Wingina then became full chief, in fact as well as in name. At that time he changed his name to Pemisapan and thereafter adopted the policy of opposing the English at every turn. He gathered about him certain confederates, such as Osacan, Tanaquiny, Wanchese, and Andacon, and chose the town of Dasamonquepeuc as the operating base for his plan of destroying the English settlement. There was no native town on the island when Governor White established his group there in 1587, or when he returned to the place in 1590. By 1587 the island was only visited by natives who came over from the mainland to hunt and fish. In that year George Howe, one of White's assistants, was slain by "divers Savages which were come over to Roanoak, either of purpose to espie our company and what number we were, or else to hunt Deere, whereof [there] were many in the Island" (129).

Both White's and De Bry's maps carry the symbol of a native settlement at the northern tip of the island of Roanoke, and Barlow stated that the village stood "neere unto the waters side" (130). None of the relations mention more than the single village, although superficial archeological reconnaissance conducted 50 years ago uncovered evidence of four sites of aboriginal occupancy (131). The excavation at that time was neither systematic nor adequate, and the investigator failed to describe both the number and the characteristics of the artifacts discovered. The island of Roanoke and the entire eastern area of the Carolinas await scientific study by trained archeologists. The early work at Roanoke revealed the possibilities of archeological studies in this region, and it is to be hoped that scientific excavation may someday be accomplished, for only by careful investigation of the native sites of occupation, such as those revealed by the contemporary narratives and early maps, can the complete history of native cultural development in this area be discovered.

In some instances tentative suggestions as to prehistoric migrations and cultural relations can be extracted from the meaning of native words, and the word Roanoak itself has been analyzed from this point of view. The modern spelling of this word is an

adaptation of the native term Roanoak, or Roanoac, as it is invariably spelled in the early narratives. Gerard claimed that in the Eastern Algonkian languages the word signified "northern people" or "northerners," and suggested that the name of this people may have derived from their location on the northern end of the island they inhabited, but more probably that it was in reference to a current tradition that they had originally migrated from an ancestral home in the north (132). That the Algonkian tribes of Virginia and Carolina came from an earlier home in the general area of the Great Lakes is the consensus of students of prehistoric migrations in eastern native North America (133).

Whereas the island of Roanoke is known to have had a native village on it at the time of the arrival of the English, it is difficult to determine which of the other islands were inhabited and which were not. White's map designates most of the larger sandbank islands by native names, but this in itself is no indication of aboriginal residence. The only island location on his map that shows the symbol of an Indian village is the northern end of Roanoke. De Bry's map shows a village here and also three towns on the island of Croatoan (134). Ocracoke Island (Wococon) was uninhabited, as was also the land near the inlet Barlow entered in 1584 (135). White found both Roanoke and "Hatorask" uninhabited in 1587. Inasmuch as there are a number of references in the relations to the mainland people crossing Pamlico Sound on hunting and fishing excursions, it is possible that the island villages were temporary settlements seasonally occupied for these purposes. On the other hand, White stated that Manteo "had his mother and many of his kindred dwelling" on Croatoan Island and referred to it as "the place where Manteo was borne and the Salvages [are] . . . our friends" (136). The proximity of the larger islands to Secotan suggests that the Indians who frequented them were members of that tribe. However, Manteo and his people were sufficiently independent of the Secotan of the mainland to refuse to join Pemisapan's conspiracy against the colonists in 1586. It is impossible to decide whether the inhabitants of Roanoke and Croatoan Islands were separate local groups, with their own tribal organization, or whether they were divisions of the Secotan tribe of the mainland. If parts of a single larger tribal territory, the distance separating the inhabitants of Roanoke Island, Cape Hatteras, and the lower Pamlico River may be assumed to have resulted in some local political autonomy and perhaps also in a degree of general cultural differentiation. However, the information embodied in contemporary accounts is too sparse to prove or disprove this theory of regional specialization.

Before we consider other original Algonkian groups of this area the relationship of the modern so-called "Croatan Indians" to the Croatoan of the sixteenth century deserves a word of mention. Among the present "Croatan" of Robeson and adjacent counties in North and South Carolina (137) there has been a persistent tradition of Indian ancestry. It has also been argued, notably by McMillan and by Weeks, that they are descendants of Governor White's "lost colonists," who are supposed to have taken refuge with the Croatoan Indians in the area of Cape Hatteras (138). In 1709 Lawson reported that some of the Hatteras Indians, as the Croatoan were known by that time, had gray eyes and that they then had a tradition of white ancestry and "value[d] themselves extremely for their affinity with the English." It was Lawson's opinion that White's settlement had miscarried, either through the want of supplies from the English or through the treachery of some of the natives, and that "in process of time they conformed themselves to the manners of their Indian relations" (139).

Lawson's theory is as reasonable as any proposed since his time, but it is an unproved hypothesis and must remain so in the nature of the case. If the Croatoan–Hatteras had absorbed their ancestral white blood as completely as Lawson suggested by the early eighteenth century, the theory of the Croatoan ancestry of the modern Croatan must be held to with temerity. The connection between the Hatteras and the ancestors of the modern Croatan is still unsubstantiated, and therefore the hypothesis of Croatan descent from either the lost

colony or the early Croatan must be regarded as quite baseless. In a recent reconsideration of the anthropological aspects of the problem, Swanton has concluded that "it is not improbable that a few families or small groups of Algonquian . . . connection may have cast their lot with" the modern Croatan, but that "contributions from such sources must have been relatively insignificant" (140). Without denying the present "Croatans" their possible Indian ancestry, we may conclude that that ancestry was almost certainly not Algonkian. From the point of view of their probable history they are legally Indians, but not ethnically Algonkian.

South of the Secotan of 1585 were the Pomouik and Neusiok tribes. The only reference to the existence of these people during the earliest historic period is in a paragraph of Barlow's *First Voyage*. I quote the passage inasmuch as it is the only information available in contemporary accounts:

> Adjoyning to this countrey aforesaid called Secotan beginneth a countrey called Pomouik, belonging to another king whom they call Piemacum, and this king is in league with the next king adjoyning towards the setting of the Sunne, and the country Neusiok, situate upon a goodly river called Neus. These kings have mortall warre with Wingina, king of Wingandacoa. But about two yeers past there was a peace made betweene the King Piemacum and the Lord of Secotan, as these men which we have brought with us to England have given us to understand. But there remaineth a mortall malice in the Secotanes, for many injuries and slaughters done upon them by that Piemacum. They invited divers men and thirtie women to the best of his countrey to their towne to a feast, and when they were altogether merry and praying before their Idol . . . the captaine or Lord of the town came suddenly upon them and slewe them every one, reserving the women and children. And these two have oftentimes since perswaded us to surprize Piemacum his towne, having promised and assured us that there will be found in it great store of commodities . . . Their persuasion be to the ende they may be revenged of their enemies (141).

The passage is of interest for a number of particulars: it establishes the fact that Manteo and Wanchese, "these men which we have brought with us to England," were Secotan tribesmen. Manteo's home village was on the island of Croatoan, which is thus indicated as a part of the Secotan tribe. Barlow also stated that the Neusiok tribe lived on the Neuse River and that the Pomouik "adjoined" the territory of the Secotan, presumably between the latter and the Neusiok. This suggests western Beaufort and northern Craven Counties as the location of the Pomouik. Their western neighbors—the "next king adjoyning towards the setting of the Sunne"—are not mentioned by name, but tribal distribution in this area suggests they may have been the Woccon, a tribe of Siouan speech (142). Piamacum's town is not named, but in the location of Pananaioc on De Bry's map we may have this tribal capital. On both De Bry's map and Smith's it is placed on the south bank of the Pamlico River toward the western end of the estuary. Mooney, who considered Pananaioc the principal tribal village of the Pomouik, located the tribe "on Pamlico river, west of the Secotan, in what is now Beaufort county" (143). However, Barlow's location of the Pomouik and Neusiok implies that these tribes "adjoined Secotan to the south, rather than to the west, and it was the "next adjoining" tribe, the group neighboring the Pomouik and Neusiok, which was "towards the setting of the Sunne." Hawks suggested that Pomouik territory was "the tract lying between the head of Bay river and Newbern" (144), and Speck thinks the Pomouik were "possibly identical with [the later] Pamlico" and locates the latter between the Pamlico River and Neuse River estuary (145). Pomouik tribal territory may be put down as including the western part of present Beaufort County, extending southward into the western and southern portions of the peninsula formed by the Pamlico and Neuse Rivers. The northeastern part of this peninsula was the southern part of Secotan territory.

The southern neighbors of the Pomouik were the Neusiok and the Coree, both of which tribes inhabited the area south of the lower Neuse River. White's map shows two native villages near the river—Newasiwac, on the south bank of the lower estuary, and Marasanico, located at the western end of Bogue Sound, perhaps at the mouth of present Whiteoak River. Correspondingly located towns on De Bry's map are Neuusiooc and Cwareuuoc. Mooney at one time re-

garded both of these towns as belonging to the Neusiok, but later he considered Cwareuuoc to have been a Coree settlement (146). Unless the latter assumption is permitted the first mention of the Coree tribe was by Governor Archdale in 1707. He described them as "a bloody and barbarous People," most of whom had been "cut off by a neighboring Nation" sometime previous to 1696 (147). Lawson named two Coree towns in 1709, with 25 fighting men, or a total population of less than 100 (148). A Coree town was located 10 miles from New Bern at the time of the founding of that settlement in 1710. Von Graffenried described it as "very well situated" on the Neuse River, but he did not state whether it was below or above his own community. He stated that there were "two chiefs in the village . . . the first an enemy of the English and the other . . . a friend" (149). He referred to this village as "Core Town" and in another communication mentioned Coram and Corutra as Indian villages on the Neuse River above New Bern (150). Their names suggest that they were Coree villages (151), and, if so, the tribe's location at this period is established as northern Craven County. Its location was somewhat farther northwest but had not changed much from that in 1585.

The Coree fought against the colonists in the Indian wars of 1711–1715 (152), and Coree stragglers were reported roaming the Neuse River frontier after peace was signed in 1715. In September of that year the Governor's Council was informed that "the Core Indians [had] made a Revolt and Dangerously wounded one of his Maj^{tes} Subjects." A small garrison was ordered established on the river "to Range upon ye Frontiers" in an attempt to effect the "Entire Destruction of ye Said nation of Indians as if there had never been a peace made with them" (153). The known history of the tribe ends with this threat of extinction. What survivors remained may have joined the Tuscarora in their migration northward to the Iroquois, by whom they were adopted into the League of the Five Nations (154).

The postcontact history of the Neusiok is similar to that of the Coree. By the later colonial period their Algonkian tribal name had been Anglicized to Neus or Neuse, and they were located somewhat westward of their situation in 1585. Maps of the early period located them on the south bank of the Neuse River near its mouth, but by 1710 they inhabited the eastern part of the area between the Trent and Neuse Rivers. In 1709 Lawson stated that they lived in two towns, Chattooka and Rouconk. Von Graffenried wrote that Chatooka was "the old name of the town of Newbern," and Rouconk is believed to have been located nearby on the Neuse River in present Craven County (155). Lawson gave the two towns but 15 warriors—approximately half a hundred people—in 1709, but Von Graffenried claimed "about a score of families" inhabited Chatooka alone. When Von Graffenried bought the site of New Bern from the Indians the natives are said to have removed to "another place . . . upon the same river not far from" New Bern. The Neuse joined the Tuscorora in the war of 1711–1712, in which the smaller tribes suffered more heavily than did the Tuscarora themselves. In September, 1712, Pollock wrote that colonial troops had "killed 40 or 50 Cores, Bare River, River Neuse and Matamusket Indian men, and took near upon 200 of their women and children, yet in all the time . . . not above 30 Tuskarora Indians were killed that we can hear of, the others being small nations not able of themselves to hurt us" (156). At the end of the war Neuse survivors probably lost their tribal identity by incorporation with the Tuscarora. Subsequent to 1715 the history of the Neuse, Coree, and Pamlico Indians is the history of their stronger native ally in the previous war against the colony. Those that were not exterminated by war, disease, and dispossession of their tribal lands found more friendly dwelling places among Iroquoian hosts in New York and Ontario. Unlike the Tuscarora and Tutelo, however, the smaller North Carolinian tribes did not survive the numerical decline and general cultural disintegration incident to their forced northward migration (157).

The Pomouik of 1585 and the Pamlico of the later colonial period lived in the same territory, and from the coincidental situa-

tion of the two it has been inferred that the latter were descendants of the former. This assumption was held by Mooney and has been accepted by Speck (158). Archdale wrote that the "Pemlicoe" had been reduced in number by a "great Mortality," perhaps smallpox, previous to 1696 (159). Lawson reported that the adult fighting men of the "Pampticough" numbered but 15—a total population of about 50—in 1709; he said they lived in one town on an island of the river, which may have been Indian Island at the mouth of the Pamlico, in eastern Beaufort County (160). The tribe fought in the Tuscarora War and suffered the fate of the smaller tribes of eastern Carolina in that struggle—tribal disorganization, resulting in ultimate disappearance. The only definite statement in the sources concerning Pomouik–Pamlico population is Lawson's figure of 15 warriors in 1709. Mooney's figure of 1,000 for the Pomouik of 1585 (161) is an estimate based upon the persistence of the tribe for more than 100 years and upon population estimates, which are little more than conjectural approximations, for neighboring tribes. Mooney's estimate is probably too high.

The linguistic position of two of the three tribes just discussed has been made the subject of a great deal of speculation. Lawson's vocabulary of 37 Pamlico words has been deemed sufficient to classify the Pomouik–Pamlico as Algonkian. To the nonlinguist, however, one of the most striking characteristics of Lawson's Pamlico vocabulary is its lack of correspondence with the words with which it can be compared in the Virginia Algonkian vocabularies given by Smith and Strachey (162). There is also Barlow's statement that the Pomouik and Neusiok had "mortall warre" with the chief of the Secotan (163), a condition that would more likely, but not necessarily, obtain between groups of different linguistic stocks than between two tribal groups of the same stock. If the Pomouik were Algonkian and were at war with the Secotan in the precontact period, it is the only instance of one Carolina Algonkian group fighting another of which there is any record in the early narratives (164). Until better evidence to the contrary is presented, however, the Pomouik may be classified as Algonkian.

The Neusiok and Coree inhabited an area in which Algonkian, Siouan, and Iroquoian languages met, and students are thereby deprived of geographical location as an indication of possible linguistic affiliation. In 1894 Mooney classified the Neusiok as probably Algonkian, on the basis of their "alliance with the Pamlico," but in 1910 he characterized them as "an unclassified tribe, perhaps of Iroquoian stock." Speck classifies them as Algonkian, stating that "Mooney . . . subsequently followed Swanton in accepting an Algonkian conviction." In a recent essay, however, Swanton refers to the Neusiok and Coree as "two small tribes on the lower course of Neuse river, [which] . . . were perhaps of Iroquoian lineage," and on his map of the linguistic stocks of the Southeast both tribes are shown in the Iroquoian area of the Tuscarora (165). The name Neusiok is Algonkian, with the characteristic terminal suffix *-ok* for "people," but it is possible that this was an Iroquoian-speaking tribe known only by the name given them by their Algonkian neighbors to the near-north.

There has been similar disagreement among students with respect to the linguistic affiliation of the Coree. In an early essay Mooney stated that "the Coree, on the coast lands south of the Neuse, may have been a tribe of the same stock" as the Tuscarora, and on his tribal map of the region he put them in the coastal Iroquoian area. In a later statement, however, he considered them as "possibly Algonquian" (166). Speck excludes the Coree from his "Carolina group" of Southeastern Algonkian, having elsewhere pointed out that "*-re* terminations in proper names and place names [are] . . . suggestive of Siouan affinity" (167). On the basis of this item of evidence the Coree might be regarded as presumptively Siouan; Speck does not suggest that they were, however. Swanton has presented "one fragment of evidence" bearing on the linguistic affinity of the Coree. He quotes Lawson who said that "I once met with a young Indian woman that had been brought from beyond the mountains [i.e., from the west] . . . She spoke the same lan-

guage as the Coramine [Coree] that dwell near Cape Lookout, allowing for some few words which were different, yet no otherwise than that they might understand one another very well." Swanton doubts that a theory of the linguistic relationship of the tribe should be built upon Lawson's incidental statement but points out that tribes of Iroquoian speech were the western neighbors of the Coree, while those of Siouan language were their neighbors to the south, and adds that Lawson's reference "seems to exclude the Siouan connection and point to Iroquoian relationship" (168).

From the point of view of the distribution of linguistic families in this region the Pomouik, Neusiok, and Coree all inhabited in interstitial area between tribes that were definitely Algonkian, Siouan, and Iroquoian. Evidence is too inadequate to permit of the classification of the tribes without a large margin of uncertainty. As a tentative formulation, however, it is perhaps not too much to suggest that the Pomouik were probably Algonkian, that the Neusiok were possibly Algonkian, while the Coree were almost certainly affiliated with a non-Algonkian stock. The evidence is nonhistorical however, and the safer position is to consider the tribes themselves as of doubtful linguistic position.

THE POSTCONTACT PERIOD

Because of the virtual lack of records from the time of the Roanoke colony until the second half of the seventeenth century, we know nothing of the history of the Weapemeoc Indians for over 70 years. During this period the Weapemeoc were reduced in numbers, had been dispossessed of their originally held tribal lands, and had become separated into bands or divisions. Currituck, Pasquotank, and Perquimans Counties, each set up as a precinct of Albemarle County in 1670, are usually said to have been named for Indian tribes inhabiting the vicinity of these political divisions (169), but the only record of native groups by these names is Lawson's reference to a "Paspatank" Indian town of 30 or 40 inhabitants, which he named after the river on which the town was located in 1709 (170). Mooney referred to the Yeopim, Perquiman, Pasquotank, and Poteskeet as "bands or sub-tribes" of the Weapemeoc of 1585 (171), but his only authority cited is Lawson, who enumerated 10 "Paspatank" and 30 "Potaskeit" adult male Indians and 6 "Jaupin (Yeopim) people" in 1709. The Jaupin are not located, but Lawson referred to the Paspatank and Potaskeit as inhabiting towns on Paspatank (Pasquotank) and North Rivers, respectively. Lawson's names for these Indian groups were, with the possible exception of Potaskeit, place names already in use by the colonists.

Only two of the four Weapemeoc bands above mentioned seem to have been commonly known by the names given them by Mooney. These are the Yeopim, who inhabited the Yeopim River region and in general the western part of former Weapemeoc territory, and the Poteskeet who lived in the eastern half. In March, 1715, the Council of Carolina was petitioned by the "Porteskyte Indians" who complained that the white inhabitants of "Corratuck Bank" were hindering them from hunting on "those their usual grounds." The natives reported that white settlers had threatened to destroy the guns of the Indians, without which they could not hunt, and that "without the liberty of hunting" they could not subsist. The Council ordered that thenceforth the Poteskeet should be permitted to hunt on any of the banks without the hindrance of the English (172). The reference is of interest in locating the Poteskeet in Currituck County and in indicating their possession of firearms by 1715. There is also mention of trade with these Indians and of their sale of tribal lands previous to that date (173). Governor Burrington included the "Pottaskites" as one of the six Indian "nations" inhabiting Carolina in 1731 and stated that they numbered then less than 20 families. Twenty years earlier the Rev. James Adams had reported "about 70 or 80 Indians . . . in the Precinct and Parish of Carahtuck . . . many of which understand English tolerably well" (174).

Information concerning the Yeopim goes back to 1662, when in the oldest recorded land grant in North Carolina, the Yeopim chief, Kilcocanen or Kistotanen, "with the consent of my people" sold to George Du-

rant a "parcell of land lying and being on Roneoke Sound and on a River called by the name of Perquimans . . . which land at present bears the name of Wecocomicke." This tract has been identified as Durant's Neck, in southern Perquimans County (175), between the Perquimans and Little Rivers. The deed identifies the area as belonging to the Yeopim, rather than "Perquiman," Indians at that period. Previous to 1714, 10,240 acres of land had been reserved for the "Yawpin" Indians, whose "King and great men" within nine years petitioned the Governor's Council to approve the sale of 640 acres "of the great Tract laid out to them by the Government." By this time George Durant was the name of a Yeopim Indian, John Durant was the tribal "king," and the other three tribal "great men" who appeared before the Council also had English names. John Durant was still chief in 1740, when he petitioned the Council "in behalf of himself and the Yeopim Nation" to be permitted "to sell and exchange their lands as may best [suit] their conveniency" (176). With this request, which was granted, the Yeopim tribe disappears from the recorded history of the colony.

The third group of native people inhabiting the area north of Albemarle Sound in the later colonial period was the Chowanoc, who retained their name of the previous century. Though diminished in numbers and reduced in territory they still occupied settlements on the river to which they had given their name. They were said to have gotten along peacefully with the whites until 1675, when they "struck swiftly and effectively in the usual Indian fashion," having been incited, it was claimed by the Carolina authorities, by the "rebellious Indians of Virginia who [had] fled to them." Thereupon the settlers of the Albemarle region made "open war" upon them by which with the loss of "many men" on both sides they were said to have been "wholly subdued." They then "had land for their habitation assigned them" (177) which was a reservation on Bennetts Creek in northern Chowan County, other tribal lands at the same time having been "resigned into the immediate possession of the Lords Proprietors as of their province of Carolina" (178). Either the precise limits of the reservation were never clearly surveyed or the land-hunger of the settlers resulted in trespass across the boundaries theoretically agreed upon, for in 1694 the Chowanoc complained to the General Court of Albemarle that they were being "much injured by the English seating soe near them," and in 1714 "Jno Hoyter on behalfe of himselfe and the rest of ye Chawan Indyons" petitioned the Governor's Council for the land "on the Eastern side of Bennets Creek including Meherins Neck," which they said was theirs by previous agreement with colonial authorities. Hoyter legitimately argued that the Chowanoc deserved their land without molestation from the settlers, inasmuch as the Chowanoc had been upon eight expeditions against "the Indian Enemy"—i.e., the Tuscarora and their allies—and that during their absences they had sufferred considerable losses in stock and crops (179). Again in 1720 "John Hoyter, Chief man of the Chowan Indians" found it necessary to protest to the Governor's Council that white people were continually intruding upon Indian land (180).

After the Tuscarora War the history of the Chowanoc is that of further reduction in population, the sale of additional land, and their gradual accommodation to the folkways of the whites. From the largest group in Algonkian Carolina in 1585 they had been reduced, according to Lawson, to 15 men—perhaps 50 people—living in one settlement on Bennetts Creek in 1709 (181). At a Council meeting in January, 1735, that body approved of the sale of ten plots of their land, totaling 2,025 acres, the reason given being that "the Chowan . . . [were] possessed of a large parcel of lands lying in Chowan precinct" and that being "but few in number" they were unable "to cultivate the same or make any benefit thereby." The Indians still retained certain "Lands on Bennets Creek" (182). There are also records of the sale of unspecified amounts of land in December, 1735, and in March, 1743; and in 1744, 640 more acres were disposed of by the "chief men of Chowan."

The tribesmen were soon complaining that the purchasers were appropriating more land than they had bargained and paid for (183). All the individuals of the tribe involved in these transactions had English names, viz. Thomas Hoyter (Hoyton, Hoyston), John Hoyter, Charles Bennet, James Bennet, John Robins, John Reading, Charles Beazley, Jeremiah Pushing, and Neuse Will. These names also occur as those of white settlers of the Albemarle communities. The accultural process had started years earlier, however. In 1712 the Rev. Giles Rainsford wrote that "Thomas Hoyle, King of the Chowan Indians . . . [was] very inclinable to embrace Christianity" and that he had expressed the desire that his son be educated in an English school (184). Rainsford located the tribal remnant in the "upper end of Chowan" precinct and stated that he had lived "5 months in Chowan Indian town and made myself Master of their language." It is a pity that, knowing the Chowan as he must have, Rainsford did not tell us more about them, for by his day they were on the verge of extinction as a group. Forty years later Bishop Spangenburg, of the Moravian Church, wrote that "the tribe of Chowans is reduced to a few families [and] their land has been taken away from them" (185). In 1754 the commander of the Chowan County militia reported to Governor Dobbs that "there is but one Indian Nation in Chowan County, which are called the Chowan Indians, but their strength is nothing and their condition very deplorable by the artifice and cunning of some of their neighbors. I am informed they consist of two men and five women and children, which two white men would at any time overcome" (186). This miserable remnant of the former tribe must have disappeared within the next few years, for no more is heard of the Chowanoc in the subsequent records of the colony.

The records of the Roanoke colony show, as we have seen, that the region between Albemarle and Pamlico Sounds was originally the home of the Secotan Indians. The descendants of these tribes went unmentioned in the historical records of the seventeenth century, except for one report. In September, 1653, Francis Yeardley of Linnhaven, Va., sent a small party of a few relatives and neighbors to "Rhoanoke" Island and the adjacent mainland. For £200 Yeardley claimed to have "purchased and paid for three great rivers" of land from "the great commander of those parts . . . his war-captains, and a great commander of another province and some other Indians . . . Actual possession was solemnly given them [Yeardley's representatives] by the great commander and all the great men of the rest of the provinces, in delivering them a turf of the earth with an arrow shot into it." With the completion of the transaction the natives are said to have "totally left the lands and rivers to us, retiring to a new habitation," which is, unfortunately, not specified. The "lands on the rivers" mentioned could not have been on Roanoke Island and must, therefore, refer to the mainland west of Pamlico Sound. "Sundry other kings of the provinces" were visited, including chiefs of villages in the tribal territory of the "Tuskarorawes" as well as the Secotan. The English were told of "a great nation called the Newxes [Neuses], . . . a great nation called the Cacores [Shakori], . . . and another great nation by these, called the Haynokes [Eno]." Subsequent to the trip of the Virginians into Carolina the "Rhoanoke emperor" paid Yeardley several visits at his home at Linnhaven, leaving "his only son, having but one" to be taught "to speak out of the book and to make a writing." At his departure the chief "expressed himself desirous to serve that God the Englishmen served, and that his child might be so brought up" (187).

Nothing more is heard of the Roanoke chief or his son, and the Roanoke Indians, as well as other Secotan descendants, faded from history for over 50 years. By the end of that period the native inhabitants south of Albemarle Sound had experienced the same sort of divisive process that had separated the Weapemeoc into bands or divisions. Writing of the first decade of the eighteenth century, Lawson mentioned two groups in this area—the Machapungo and the Hatteras, the former numbering 30

adult men in the Town of Maramiskeet and the latter having 16 men in a town near Cape Hatteras. Lawson added one item of Machapunga tribal history in stating that they and the Coranine (Coree) "had been a long time at war together, (having but) lately concluded a peace" (188).

In the eighteenth-century records of the colony the Machapunga were usually known as the Mattamuskeet, the latter name being derived from that of the principal village. The fact that they impressed their name upon the lake in Hyde County and that Pungo River and Creek in eastern Beaufort County were also named after them gives an indication of their tribal location. There is an indication, also, in the meaning of their name, although decision as to the latter is a somewhat doubtful process, depending upon interpretation of the phonetic elements involved in the original tribal eponym. Heckewelder derived the name from *matchi-pungo*, meaning "bad dust"; Mooney, however, suggested *massa-pungo*, " 'great or much dust,' in allusion to the sandy soil of the district" (189). Speck calls attention to the fact that the element *pung* may signify either sand or dust or "pond," and suggests that "great pond or lake [people]" is a more appropriate etymology (190).

During the Tuscarora War the Mattamuskeet went on record a number of times for their activities in that struggle. Von Graffenried mentioned the "Marmusckits from the rivers Bory, Wetock, Pamtego, Neus, [and] Trent" and the "Cor [Coree] Indians" as Tuscarora allies who fought against the settlers. Pollock classified the "Matamusket,' among the smaller enemy tribes who, without the aid of the stronger Tuscarora, were at first considered "not able of themselves to hurt us" (191). Pollock later wrote of "some Matamuskite Indians disturbing the people at Matchepungo" and claimed that the same group had "killed and carried away about 20 persons at Roanoke Island and at Croatan." They also attacked the settlers at Alligator River, killing or capturing some 16 or 20 of the inhabitants (192). There are several references to their manner of fighting. Von Graffenried wrote that they made their attacks by "small platoons," which plundered and killed the whites at their isolated plantations. Pollock commented a number of times upon their taking advantage of "dismal swamps to fly into" and stated that in the woods and "pocosuns" the Indians were superior to the whites. In "lakes, quagmires, and cane swamps . . . it is almost impossible for white men to follow" the Indians, who have "boats and canoes, being expert watermen, wherein they can transport themselves where they please" (193).

By the summer of 1713, after two years of warfare, a peace was concluded with Tom Blunt (or Blount), chief of the northern Tuscarora towns. The Mattamuskeet and Coree were not a party to these negotiations, Pollock stating at the time that "if Blount keeps the peace we shall have only the Mattemuskeet and Core Indians to mind, who of late have done us great mischief . . . The army are now out against the Mattemuskeet Indians, in which expedition if they succeed it will go near to finish the war" (194). Within a few months it was reported that there was "no enemy to go against, but a few Mattamuskeets" and that only "stragglers [were] left of the Cores or Cotechnees and Matamuskeets" (195). By 1715 peace was concluded with the totally defeated Indians and a reservation was established for the survivors at Mattamuskeet Lake. The Governor was instructed to appoint an overseer "to live with ye Said Indyans . . . at Mattamuskeet . . . the better to Inspect into their behavior and to remit accounts thereof" (196). This marks the establishment of North Carolina's first Indian reservation with a resident commissioner paid for and responsible to the governing authorities.

There is no indication of the number of natives who took advantage of the reservation, for some of the survivors seem to have joined the Tuscarora and Siouan tribes in their trek toward the north. During the last two years of the war Pollock's letters referred to the coastal Indians as "few" in number, wasted, "stragglers," and a remnant. However, for a group accorded but 30 warriors in 1709 the Mattamuskeet seem

to have offered their share of trouble during the four years of the war. In 1731 Governor Burrington reported that the "Maremuskeets" lived on their reservation "secure from the attacks of Forreign Indians" and that they had been "of late years . . . much diminished" and numbered less than 20 families (197). Returns for about 1760 gave "about 8 or 10 Maramuskeet" Indians on the mainland with about "as many on the Islands or Banks" (198). In 1761, and again in 1763, the Rev. Alexander Stewart referred to "the remains of the Altamuskeet, Hatteras and Roanoke Indians [which] live mostly along the coast [of Hyde County], mixed with the white inhabitants." They attended Stewart's services, "behaved with decency, seemed desirous of instruction, and offered themselves and their children . . . for baptism." This missionary baptized 7 Indians in 1761 and 21 in 1763, all of whom he described as being "fond of hearing the Word of the true God, . . . of being admitted into the church," and as having as much "notion of any religion" as the whites of the neighborhood (199).

Nothing is heard of the Mattamuskeet or of any other Carolina Algonkian group in the nineteenth century. All records of the previous century denote the numerical paucity of the coastal tribes and suggest that the surviving people were interested in learning and conforming to ways of the settlers. The final few remaining descendants must have become merged with the negroes and whites of the frontier community. Aboriginal culture was largely lost as the result of the impact of culture of Old World derivation. The extent to which this is true is shown by Professor Speck's search for ethnic and cultural survivals in the area formerly inhabited by one group of the Algonkian aborigines. "Persistent inquiry" by this investigator uncovered "a few families of mixed blood," whom he regarded as "descendants of the local Indian tribes" living on the coast of Dare and Hyde Counties and on the adjacent islands in 1916. Their descent was traced from "Indians who came originally from Pungo river," and they are put down as "evidently remnants of the Machapunga tribe." In appearance they are described as varying greatly "from individuals with pronounced Indian characteristics, through people with noticeable white or Negro features, the latter sort predominating in the younger generations." No more than the merest fragments of a former Indian way of life were discovered among these mixed bloods. "Not one of these people knew a single word of the Indian language and not one knew of any definite Indian customs or traditions, not even the name of their tribe" (200).

Speck's survey shows that neither ethnology nor native history can be rescued from the memories of living descendants. Archeological excavation and the study of documentary sources remain the only methods by which ethnic history can be investigated in this important area of aboriginal America. The present study has shown that, contrary to the usual impression, the various Algonkian groups of the coastal area are not all to be considered as contemporary inhabitants of the region of their occupancy. Historic perspective reveals that the native tribes of this region must be differentiated into those of the period of the earliest explorations and those of the period of later colonization. The Algonkian of the former period (1584 to 1590) were the Weapemeoc, Chowanoc, Moratoc, Secotan, Pomouik, and Neusiok. Those of the later period (*c.* 1650 to *c.* 1800) were the Yeopim, Poteskeet, Chowan, Machapunga (Mattamuskeet), Pamlico, and Neuse. At the time of discovery the native tribes were large and the indigenous cultures were living realities. By the end of a century and a half of white contact tribes were disorganized, the native population had all but vanished, and the original local cultural properties had disappeared. The ethnohistorical process in the Algonkian area of Carolina was one marked by disturbance, defeat, decline, disorganization, and final extinction.

NOTES

(106) *HAI* **2**: 495, 1173.

(107) Mooney's figure of 1,200 persons for the "Wingandacoa of 1585" is an estimate deduced from the size of remnant bands of the Secotan (Machapunga, Hatteras, etc.) in the later colonial period, i.e., *c.* 1700 (*Aboriginal Population North of Mexico:* 6, 1928). The Roanoke records give no information whatsoever on Secotan population in 1585.

(108) LANE, p. 142; HARIOT, p. 186; BARLOW, p. 127. For White's drawings see BUSHNELL, 1927, pls. 7, 8, opp. pp. 428, 429, or BINYON, 1925, pls. 24, 27.

(109) White's *Fifth voyage*, Hakluyt, p. 221.

(110) EDWARD CHANNING, *History of the United States* **1**: 130, 1905. On the other hand, Croatoan was frequently visited by the colonists when watching for the arrival of their expected supplies from England.

(111) *The voiage made by Sir Richard Greenvile, for Sir Walter Ralegh, to Virginia, in the yeere 1585*, Hakluyt **6**: 132–139. I ascribe authorship to Grenville, rather than to Lane, inasmuch as the narrative deals with events up to and including Grenville's return to England; however, both "our Generall Sir Richard Greenevil" and "our Lieutenant Master Ralph Lane" are referred to in the third person, as if neither were the author. The account is in the form of a daily journal and must, therefore, have been written by a member of the expedition.

(112) Misprint for Werowan's; in De Bry this picture is entitled "A chieff Ladye of Pomeioc" (De Bry, pl. 8; for original see BUSHNELL, 1927, pl. 4, opp. p. 425, or BINYON, p. 28-b).

(113) Hakluyt **6**: 129.

(114) MOONEY, *HAI* **2**: 276; HAWKS, *History of North Carolina* **1**: 85, 237, 238. Tarbox is entirely incorrect in saying that "Pomeiok . . . seems to have been the chief town of the Indians called the Newsioks, [and] was on or near the Neuse River . . . [near] the spot where now stands the town of Newbern" (*op. cit.:* 140n.)

(115) BUSHNELL, 1927, pl. 7, opp. p. 428 (also in Amer. Anthrop. **9**(1): opp. p. 32, 1907); BINYON, pl. 27-a.

(116) *HAI* **1**: 71.

(117) *History of North Carolina* **1**: 101. Here Hawks made the mistake that he warned his readers against in another connection: "The district of Pomouik must therefore not be confounded with the town of Pomeiock" (p. 85). Tarbox repeated Hawks's error in placing Aquascogoc "on the Neuse River, some little way up from its mouth" (*Sir Walter Ralegh's colony:* 140n). Tarbox gave Hawks credit for doing "as much perhaps as any one to find and fix the places covered by the Indian names" of the Roanoke relations, and throughout his own book repeated Hawks's erroneous locations.

(118) GRENVILLE, in Hakluyt **6**: 137–138.

(119) Hakluyt **6**: 129 (Barlow), 141 (Lane).

(120) White's and De Bry's maps, and all subsequent maps based upon the latter, show that Wococon was the native name for modern Ocracoke Island.

(121) *HAI* **2**: 295.

(122) *History of North Carolina* **1**: 74, 101.

(123) *HAI* **1**: 352.

(124) *HAI* **1**: 829.

(125) *HAI* **2**: 801.

(126) Hakluyt **6**: 127.

(127) *Ibid.:* 155 (Lane), 221 (White).

(128) *Ibid.:* 155, 156.

(129) *Ibid.:* 201 (White's *Fourth voyage*); 221–222 (White's *Fifth voyage*).

(130) *Ibid.:* 127.

(131) TALCOTT WILLIAMS, "The Surroundings and Site of Raleigh's Colony," Ann. Rep. Amer. Hist. Assoc. for 1895: 54–60, 1896.

(132) W. R. GERARD, "Virginia Indian Contributions to English," Amer. Anthrop. **9**(1): 106, 1907; also *HAI* **2**: 392. Gerard claimed that "Roanoke" as a name for the shell beads used by the natives as ornaments and as a medium of exchange was a misnomer, due to the colonists' mishearing of the original word, which Smith gave as *rawrenock* (*Works*, Arber, p. 46), and Strachey gave as *rarenaw* (*Historie*, p. 185). This word, with the root *rar* meaning to "rub, abrade, smooth, or polish," according to Gerard's etymology, meant "smoothed shells" (*HAI* **2**: 393). However, Lawson gave "ronoak" as the Pamlico word for "peak" in his short vocabulary of the tribe. (*History*, 1937 ed., p. 243). It is possible that by 1709 the Pamlico had accepted an English corruption of the original Algonkian word.

(133) D. I. BUSHNELL, JR., "Tribal Migrations East of the Mississippi," Smithsonian Misc. Coll. **89**(12): 2–3, maps 1–4, 1934; KAJ BIRKET-SMITH, "A Geographical Study of the Early History of the Algonkian Indians," Internat. Archiv für Ethnogr. **24**, 1918; *idem*, "Folk Wanderings and Cultural Drifts in Northern North America," Journ. Soc. Américanistes de Paris **22**: 1–32, 1930.

(134) Croatoan is now usually identified as the land between Ocracoke Island and Cape Hatteras. Some have given it a more southern location, on the northern part of present Portsmouth Island (e.g., Mooney, *HAI* **1**: 365).

(135) Hakluyt **6**: 122–124, 130.

(136) *Ibid.:* 202, 223.

(137) For the number and present social status of this group see O. M. MCPHERSON, *Report on the condition and tribal rights of the Indians of Robeson and adjoining counties of North Carolina* (Senate Doc. 677): 7–40, 120–132, 223–252, 1915; and R. M. HARPER, "A Statistical Study of the Croatans," *Rural Sociology* **2**(4): 444–456, 1937.

(138) HAMILTON MCMILLAN, *Sir Walter Raleigh's lost colony*, privately printed, Raleigh, 1907; *idem*, "The Croatans," North Carolina Booklet **10**: 115–121, 1911; STEPHEN B. WEEKS, "The Lost Colony of Roanoke: Its Fate and Survival," Papers Amer. Hist. Assoc. **5** (pt. 4): 107–146, 1891; *idem*, "Raleigh's Settlements on Roanoke Island, An Historical Survival," Mag. Amer. Hist. **25**: 127–139, 1891. McPherson and D. L. Rights have reviewed the arguments for and against the Croatoan affiliation but are personally noncommital (McPherson, *op. cit.:* Rights, "The Lost Colony Legend," Bull. Arch. Soc. North Carolina **1**(2): 3–7, 1934).

(139) *History of Carolina*, 1937 reprint, p. 62.

(140) J. R. SWANTON, "Probable Identity of the 'Croatan' Indians," U. S. Department of the Interior, Office of Indian Affairs (typescript), p. 5, 1933. Swanton concludes that probably "certain Siouan tribes" of the Southeast mainly contributed to the Indian ancestry of the modern Croatan. "If the name of any tribe is to be used in connection with this body of . . . people, that of

the Cheraw would, in my opinion, be most appropriate."

(141) Hakluyt **6**: 130–131.

(142) Mooney, *The Siouan tribes of the East:* 65 and map opp. p. 5; *idem, HAI* **2**: 967–968; Lawson, *History* (1937 ed.), frontispiece map.

(143) *HAI* **2**: 277.

(144) *History of North Carolina* **1**: 74.

(145) Amer. Anthrop. **26**(2): 188, 189 (map), 1924.

(146) *HAI* **1**: 222 (Cawruuoc); **2**: 60 (Neusiok); *Aboriginal population of America North of Mexico:* 6, 1928 (Neuse and Coree = Nusiok and Cawruuock).

(147) *A new description of . . . Carolina* (London, 1707), in A. S. Salley, ed., *Narratives of Early Carolina:* 286, 1911. Archdale refers to them as the "Coranine . . . Nation of Indians."

(148) *History,* 1937 ed., p. 255. Lawson calls them "Connamox" Indians, with Coranine and Raruta as the names of their towns.

(149) V. H. Todd, ed., *Christoph von Graffenried's account of the founding of New Bern:* 376–377, 1920.

(150) Von Graffenried to Governor Hyde, *Colonial records of North Carolina* **1**: 990.

(151) Hewitt listed Coram and Corutra as settlements of the Tuscarora (*HAI* **2**: 852). They were located on the border of Tuscarora and Coree territory, and it is difficult to determine to which tribe they should be accorded.

(152) *Colonial records of North Carolina* **1**: 827, 868, 875, 934, 955, 990–992; **2**: 24, 29, 39, 45, 62, 168 indicate Coree participation in the Tuscarora War. For this conflict as an aspect of the history of the colony see R. D. W. Connor, *History of Carolina:* 1 (ch. 7), 1919, and Archibald Henderson, *North Carolina: The Old North State and the New* **1** (ch. 4), 1941. For its ethnological aspects see J. N. B. Hewitt, "Tuscarora," *HAI* **2**: 842–853, and C. W. Milling, *Red Carolinians:* ch. 8, 1940.

(153) *Colonial records of North Carolina* **2**: 200, 244.

(154) Mooney stated that "in 1715 the remnants of the Coree and Machapunga were assigned a tract on Mattamuskeet lake . . . where they lived in one village, probably until they became extinct" (*HAI* **1**: 349). There is but one reference in the colonial records which suggests that the Coree were included in the Mattamuskeet reservation (*Colonial records of North Carolina* **2**: 168). They more probably joined the Tuscarora remnant in its northward migration. (For the Tuscarora in North Carolina their migration northward, and their adoption by the Iroquois, see J. N. B. Hewitt, "Tuscarora," *HAI* **2**: 842–853.)

(155) *History,* 1937 ed., p. 255 and map (frontispiece); Von Graffenried, in *Colonial records of North Carolina* **1**: 910, 933, 978; Mooney, *HAI* **1**: 237; **2**: 60, 397; V. H. Todd, *op. cit.:* 234, 373–374.

(156) *Colonial records of North Carolina* **1**: 875; also pp. 843, 933–934, 955 for Neuse participation in the war.

(157) Approximately 400 Tuscarora today live on a reservation near Niagara Falls, N. Y., and Speck has found the tradition of Tutelo tribal identity preserved among half a hundred Tutelo mixed descendants who live among the Iroquoian Cayuga at Six Nations Reserve near Brantford, Ontario. (See map of Iroquoian reservations and settlements in 1940, W. N. Fenton, "Problems Arising from the Historic Northeastern Position of the Iroquois," in *Essays in Historical Anthropology of North America,* Smithsonian Misc. Coll. **100**: 214–215, 1940. Also F. G. Speck, *The Tutelo spirit adoption ceremony:* v–xvii, 1–3, Pennsylvania Historical Commission, 1942.) There is no similar trace of Neuse, Pamlico, or Coree descendants among modern mixed peoples.

(158) Mooney, *HAI* **2**: 277 (Pomouic); Speck, Amer. Anthrop. **26** (2): 188, 1924.

(159) *A new description . . . of Carolina* (London, 1707), in A. S. Salley, ed., *Narratives of Early Carolina:* 286.

(160) *History of Carolina,* 1937 reprint, p. 255.

(161) *Aboriginal population of America north of Mexico:* 6, 1928.

(162) Compare, for example, the words for the numerals from 1 to 10 given by these three authors (Lawson, *History of Carolina,* 1937 reprint, pp. 240–243; Smith's *Works,* Arber edition, pp. 44–46; Strachey, *Historie:* 183–196).

(163) Hakluyt **6**: 130.

(164) The entrance of the English, of course, disturbed the native situation, and wars within linguistic stocks occurred; for example, one section of the Tuscarora tribe fought against the colonists while another fought with them in the wars of 1711–1715.

(165) Mooney, *The Siouan tribes of the East:* 7, 1894; *idem, HAI* **2**: p. 60, 1910; Speck, Amer. Anthrop. **26**(2): 187n, 188, 189 (map), 1924; Swanton, "The Probable Identity of the 'Croatan' Indians," U. S. Department of the Interior, Bureau of Indian Affairs: p. 2, 1933; *idem,* "The Southeastern Indians of History," *Conference on Southern Prehistory:* map no. 1, opp. p. 98, 1932.

(166) *The Siouan tribes of the East:* 8, frontispiece map; *HAI* **1**: 349.

(167) "The Ethnic Position of the Southeastern Algonkian," Amer. Anthrop. **26** (2): 187–188, 1924; "The Possible Siouan Identity of the Words Recorded from Francisco of Chicora," Journ. Washington Acad. Sci. **14**(13): 303, 1924. Siouan tribes in the Southeastern area with the characteristic termination Dr. Speck alludes to were Shoccocree (Shakori), Sugaree, Wateree, Congaree (and Coree?). There were also the Saponi, Occaneechi, Keyauwee, Pedee, Santee, and Sewee. The terminations *-i, -e,* or *-ee* practically never occur in Eastern Algonkian proper names.

(168) J. R. Swanton, "Unclassified Languages of the Southeast," Internat. Journ. Amer. Linguistics **1**: 3, 1917.

(169) E.g., J. H. Wheeler, *Historical Sketches of North Carolina* **2**: 132, 339, 341, 1851; C. C. Crittenden and D. Lacy, eds., *The Historical Records of North Carolina: The County Records* **2**: 42, 1938 (Currituck County); **3**: 114, 142, 1939 (Pasquotank and Perquimans Counties).

(170) *History,* 1937 reprint, p. 255.

(171) *Siouan tribes of the East:* 7, 1894; *HAI* **2**: 207, 234, 293, 297, 1910. Speck considers the Yeopim the same as the Weapemeoc and the Pasquotank, Perquiman, and Poteskeet as "probably" divisions of the latter (Amer. Anthrop. **26** (2): 187–188, 1924).

(172) Council Journal, 1715, *Colonial records of North Carolina* **2**: 172.

(173) *Colonial of North Carolina* **2**: 22, 734 (1703, "Portes Leites" Indians), 141 (1714, "ye

Poteskeyt Towne"), 204–205 (1175, "Porteskill" Indians).

(174) *Ibid.* 3: 153; 1: 734.

(175) *Ibid.* 1: 19; H. T. Lefler, *North Carolina history told by contemporaries:* 14–15, 1934; R. D. W. Connor, *History of North Carolina* 1: 27, 1919.

(176) *Colonial records of North Carolina* 2: 140, 483; 4: 446.

(177) Pollock letter to the Virginia Council, June 17, 1707, *Colonial records of North Carolina* 1: 657–658.

(178) Mooney, *HAI* 1: 292; R. D. W. Connor, *History of North Carolina* 1: 50–51.

(179) *Colonial records of North Carolina* 2: 140–141; also 1: 857–860, for the Chowanoc participation in the war of 1711–1712 on the side of the colonists. Mooney is incorrect in placing them in the Tuscarora War against the whites (*HAI* 1: 292).

(180) *Colonial records of North Carolina* 2: 379–380.

(181) *History of Carolina*, 1937 reprint, p. 255.

(182) *Colonial records of North Carolina* 4: 33–35. The average purchase price was *c.* $1.85 an acre (with the £ at par); in addition 100 acres were sold for 60 barrels of tar.

(183) *Ibid.* 4: 74–75, 630–632; 2: 379–380.

(184) Letter of G. Rainsford to the Society for the Propagation of the Gospel in Foreign Parts, *Colonial records of North Carolina* 1: 857–860.

(185) Spangenburg Diary, entry dated Edenton, September 13, 1752, *Colonial records of North Carolina* 5: 1. There is a more complete version of the Spangenburg diary in A. L. Fries, ed., *Records of the Moravians in North Carolina* 1: 36 ff., 1922.

(186) James Craven to Governor Dobbs, Edenton, December 7, 1754, *Colonial records of North Carolina* 22: 329; also p. 312.

(187) Francis Yardley to John Farrar, Linné-Haven, Va., May 8, 1654, in A. S. Salley, ed.' *Narratives of early Carolina:* 25–29. The Shakori and Eno were interior tribes, living just west of the Tuscarora. For identification of Cacores as Shakori and Haynokes as Eno, see J. Mooney, *The Siouan Tribes of the East:* 62–64, and *HAI* 1: 426; 2: 521.

(188) *History of Carolina:* 255, 212.

(189) *HAI* 1: 781.

(190) Personal Communication, December, 1942.

(191) Von Graffenried, *Colonial records of North Carolina* 1: 933–934; Thomas Pollock to the Lords Proprietors, September 20, 1712, *ibid.:* 875.

(192) *Colonial records of North Carolina* 2: 29, 31, 39, 45.

(193) *Ibid.* 1: 875; 2: 28, 38, 39, 45.

(194) Pollock, May 25 and June 25, 1713. *Colonial records of North Carolina* 2: 45, 52–53.

(195) Pollock, September 1, 1713, *ibid.:* 61–62. Pollock was mistaken in identifying the Coree with the "Cotechnees." Cotechney was a large Tuscarora town, the home of Hancock, one of the principal Tuscarora chiefs and the colonists' chief Indian enemy during the first years of the war. The town was the scene of the execution of Lawson in 1711 and was located in eastern present Greene county, near the mouth of Contentnea Creek. (J. N. B. Hewitt, *HAI* 1: 352; 2: 846, 852.)

(196) Council Journal, *Colonial records of North Carolina* 2: 168, 316.

(197) *Ibid.* 3: 153.

(198) *Ibid.* 5: 321; 6: 616.

(199) Rev. Alexander Stewart to the Society for the Propagation of the Gospel in Foreign Parts, *Colonial records of North Carolina* 6: 563, 995.

(200) "Remnants of the Machapunga Indians of North Carolina," Amer. Anthrop. 18(2): 271–272, 1916.

ENTOMOLOGY.—*The Mexican species of leafhoppers of the genus* Texananus (*Homoptera: Cicadellidae*).[1] Dwight M. DeLong, Ohio State University. (Communicated by C. F. W. Muesebeck.)

A paper dealing with the Mexican species of *Texananus* including the new species then at hand was published together with the Mexican species of *Phlepsius* in 1939. Since that time the writer has had the opportunity of collecting additional material in several states of Mexico in company with C. C. Plummer, J. S. Caldwell, and E. E. Good. As a result 27 species of the genus have now been taken in Mexico, 6 of which are described as new at this time and 19 of which are known only from Mexico. In comparison, 20 species are known to occur only in the United States and 8 species are found in both countries. In addition to the 6 new species described, 3 male allotypes are described, one species placed in synonomy and many new records cited of geographical and altitudinal distributions. All types are in the author's private collection.

[1] Received January 4, 1944.

Genus Texananus Ball

Texananus cuspidatus DeLong

Texananus cuspidatus DeLong, Anal. Esc. Nac. Cien. Biol. 1: 382. 1939.

In addition to the records of material collected in Chiapas at elevations of about 2,500 feet near Finca Vergel, specimens are at hand from Fortín, Veracruz (3,200 feet) and Tamazunchale, San Luis Potosí (350 feet). This species apparently is associated rather definitely with the low altitude tropical vegetation of the monsoon forest association.

Texananus ovatus (Van Duzee)

Phlepsius ovatus Van Duzee, Trans. Amer. Ent. Soc. **17**: 79. 1892.

Several species resemble *ovatus* in general appearance and at the time Dr. Ball reported *ovatus* for Mexico (1918) they had not been separated by male genital structures. Although collecting has been carried on in many areas, none of the members of this group can be identified as *ovatus*. It is the writer's opinion, therefore, that the reference to *ovatus* is to a closely related species and that *ovatus* does not occur in Mexico.

Texananus barbus, n. sp.

In form and general appearance resembling *ovatus* but with distinct male genitalia. Length 5 mm.

Vertex bluntly angled, a little more than half as long at middle as basal width between eyes.

Color: Vertex pale, mottled with brown, except for a circular band just posterior to apical portion and a pale spot at base next each eye. Scutellum with a dark spot each side of middle at base, a dark spot about middle of outer margin, each side, a white spot just behind each marginal dark spot and a white spot at apex. Elytra pale, with the three pale lobate spots along commissure separated by black spots at ends of the claval veins. Darker spots along costal margin and on discal and anteapical cells. Face rather heavily mottled with brown.

Genitalia: Male valve triangular, strongly produced, apex bluntly angled. Plates short and broad, outer margins strongly convexly rounded to blunt apices which are divergent. Pygofers longer than plates. Styles long, narrowed somewhat at base and produced as rather broad processes to bluntly angled tips. Aedeagus with a ventral portion that is narrowed and produced to a sharp-pointed apex, just before which it is armed with a pair of conspicuous barbs. The dorsal portion is sickle-shaped, with the sickle blade not narrowed or pointed at apex.

Holotype male collected at Zacapu, Michoacán (6,500 foot elevation), October 4, 1941, by Caldwell, Plummer, Good, and the author.

Texananus serrellus, n. sp.

Resembling *ovatus* in form and general appearance but with distinct genital structures. Length 5.5–6 mm.

Vertex bluntly angled, more than one-half as long at middle as basal width between the eyes.

Color: Vertex pale with heavy brown markings each side of pale apex and an area of dark markings each side of middle between the eyes. These markings form a pale line between the ocelli, a median pale longitudinal stripe on basal half, and the basal margin pale. Pronotum pale, with a few dark markings on anterior margin. Scutellum pale with a round black spot each side of middle on anterior portion and a transverse black line at middle. Elytra rather evenly marked with brown pigment except the elytral margin along scutellum and anterior clavus, which is white, margined with darker pigment. The central lobate spot on clavus and a smaller lobate spot on apex of clavus. Face rather heavily marked along margins with dark brown pigment and with two brown spots just above clypeus.

Genitalia: Female last ventral segment with posterior margin broadly angularly excavated, a small notch at the apex of the shallow excavation. The median two-thirds is brown-margined. Male valve rather long. Apex rounded. Plates short, broadly convexly rounded, to near apex where they are concavely rounded to form blunt tips. Pygofer decidedly longer than plates with saw-tooth spines on the caudal ventral side.

Styles long, narrowed slightly at middle, then slightly broadened to form blunt rounded tips. Aedeagus with a ventral portion that is broad in lateral view with a slightly broadened apex consisting of a sharp pointed toe which extends dorsally and a slightly produced and pointed heel on the ventral apical margin. The dorsal portion is somewhat sickle-shaped, with a long rather narrow handle, a dorsal spur at the base of the broad blade which is irregularly but strongly narrowed to a blunt apex.

Holotype male collected at Mexcala, Guerrero, Mexico (1,700 foot elevation), October 22, 1941. Allotype female, paratype males, and paratype females from Iguala, Guerrero, Mexico (2,500 feet), October 25, 1941. Paratype males collected at Zacapu, Michoacán (6,500 feet), October 4, 1941; Zitacuara, Michoacán (7,500 feet), September 29, 1941; Carapan, Michoacán (7,500 feet), October 2, 1941; Jiutepec, Morelos (4,000 feet), September 6, 1939, and Acapulco (sea level), September 10,

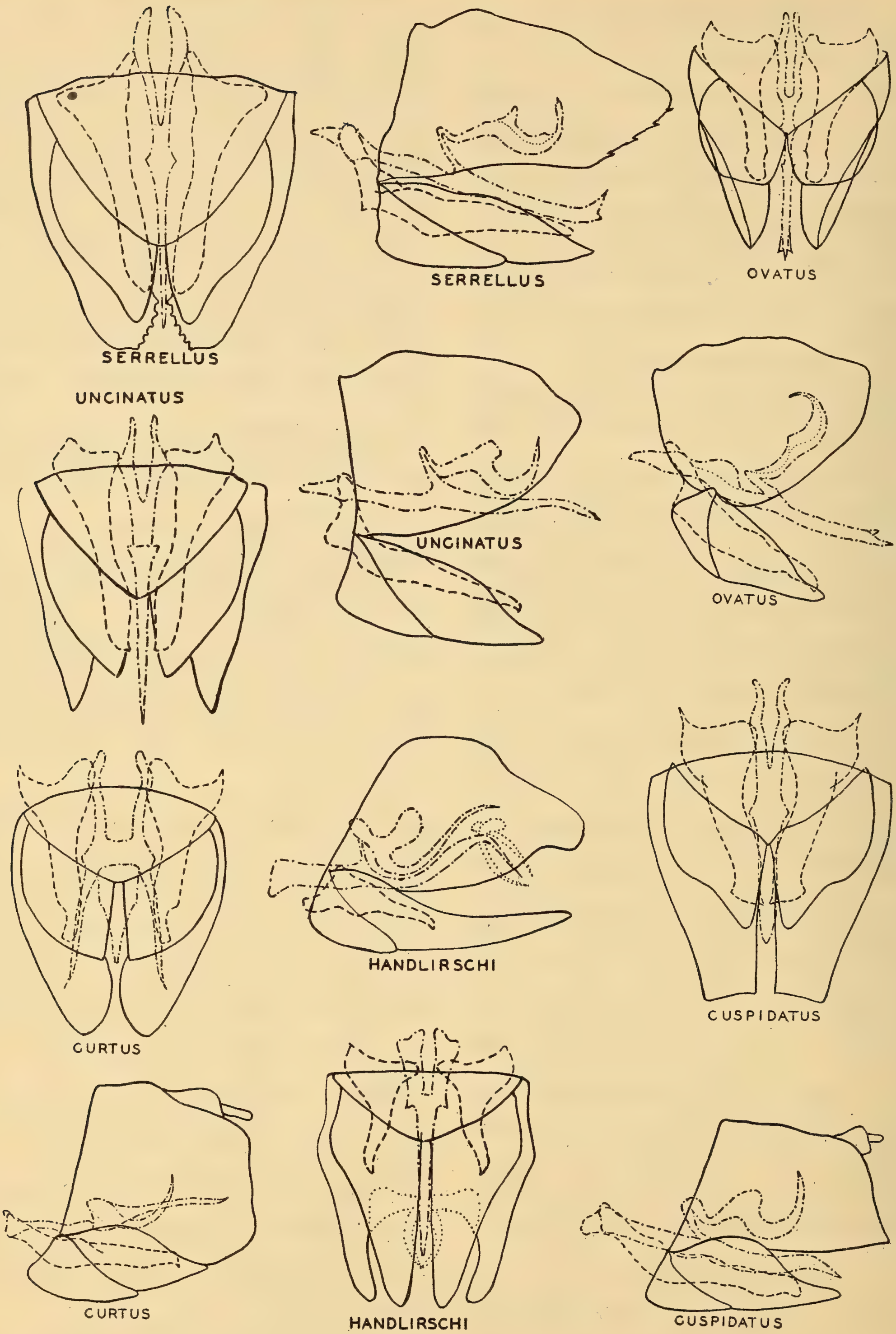

Fig. 1.—Ventral and lateral views of male genital structures of species of *Texananus* as labeled.

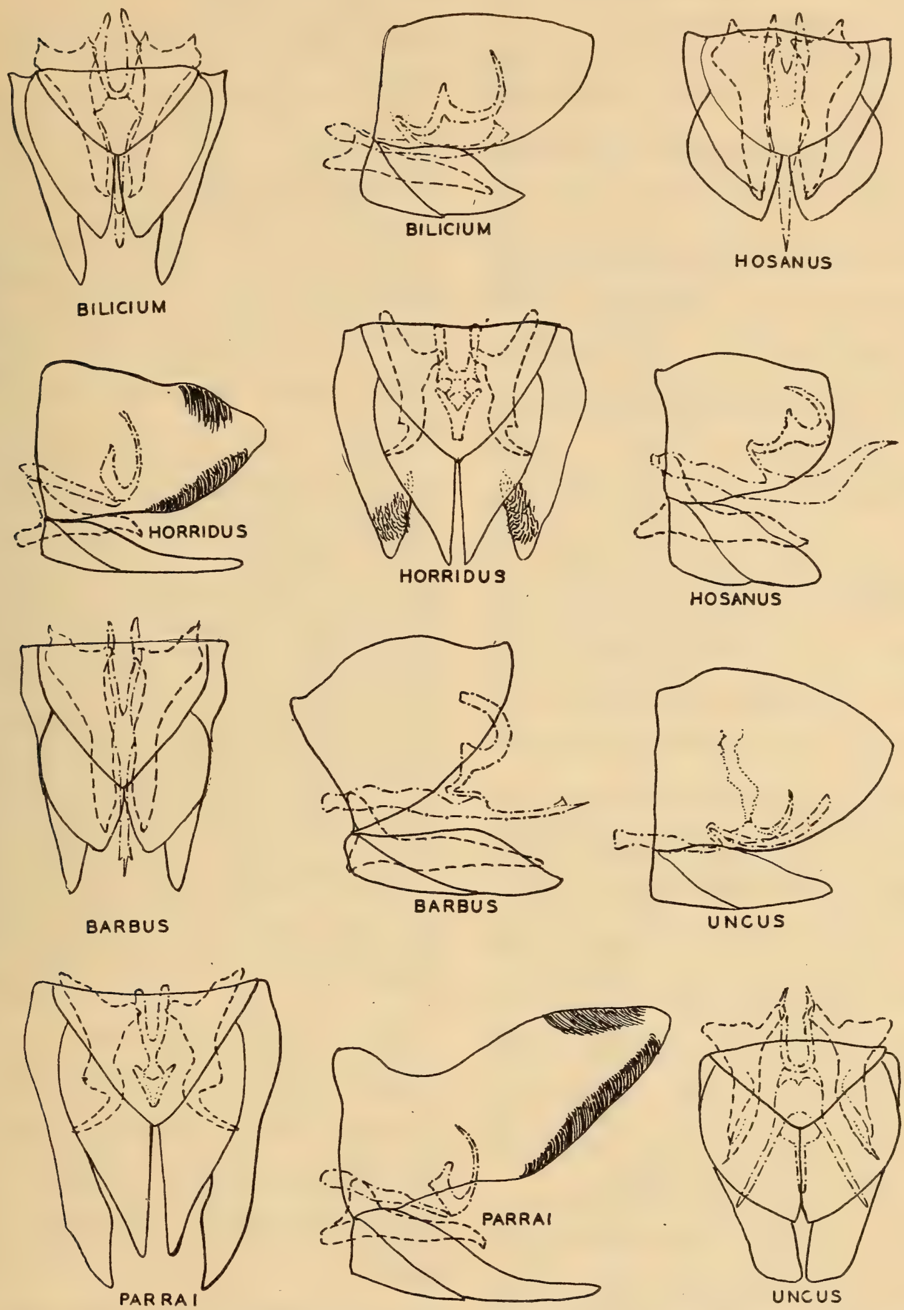

Fig. 2.—Ventral and lateral views of genital structures of species of *Texananus* as labeled.

1939, all collected by C. C. Plummer, J. S. Caldwell, E. E. Good, and the author.

Texananus bilicium, n. sp.

Resembling *ovatus* in form and general appearance but with distinct male genitalia. Length 6 mm.

Vertex almost transverse, scarcely angled, almost twice as wide between eyes at middle as median length.

Color: Vertex pale with a median reddish longitudinal line, a small area of dark pigment each side of pale apex. A conspicuous pale band between ocelli, a large area of dark pigment each side of middle on basal half. Basal margin white. Pronotum dull grayish brown with a pair of black spots just behind each eye on anterior margin and a large comma spot on anterior margin just posterior to median portion of vertex each side of middle. Scutellum with a round black spot either side of middle on anterior portion and a small spot in each basal angle. Elytra rather evenly marked with dark brown pigment except the white anterior margin along scutellum and the basal one-third of clavus along commissure, and two white lobate spots on middle and apical third of clavus. Face rather evenly marked with dark brown pigment.

Genitalia: Male valve short, triangular, apex blunt. Plates elongate convexly rounded to blunt apices. Styles long, gradually narrowed from base to sharp pointed apices, which are curved inwardly. Aedeagus with ventral portion rather short, about as long as plate, curved dorsally and broadened at apex which is truncate with a projecting point or tooth on dorsal margin. The dorsal portion is composed of two concave attached U-shaped structures. The basal U is smaller and narrow; the apical U is broad, larger, and with a slender sharp pointed apex which extends dorsally. The pygofer greatly exceeds the plates in length.

Holotype male collected at Zacapu, Michoacán, Mexico (6,500 foot elevation),October 4, 1941; paratype male from Zitacuara, Michoacán (7,500 feet), September 29, 1941, collected by E. E. Good, J. S. Caldwell, C. C. Plummer, and the author.

Texananus uncinatus, n. sp.

Resembling *ovatus* in form and general appearance but with distinct genitalia. Length 6–6.5 mm.

Vertex broad, bluntly angled, more than one-half as long at middle as basal width between the eyes.

Color: Vertex pale with faint brown markings at the apex and a small brown area each side of middle on basal half. Pronotum with two black spots behind each eye on anterior margin and a curved comma mark on anterior margin each side of middle. Scutellum pale with a round black spot each side of middle on anterior portion. Elytra marked with brownish pigment lines except a pale margin bordering the scutellum and the lobate spots along commissure of clavus. Face marked with brownish pigment.

Genitalia: Female last ventral segment with the lateral margins rounding to posterior margin, which is truncate with a rather broad, deep U-shaped notch on median third. Male valve strongly produced, apex blunt. Plates rather short, convexly rounded to form blunt apices. Styles elongate, extending almost to apex of plates, constricted near middle then broadened to form blunt, rounded apices, which are pointed on inner apical margins. Aedeagus with a ventral portion which is rather broad at base in lateral view and is gradually tapered to a narrow pointed apex extending to the apex of pygofer. The dorsal portion of the aedeagus is sickle shaped with a short blade. The handle portion is produced beyond the base of the blade and is truncate. The blade is broad at the base and rapidly narrowed at about half its length to form a sharp pointed apex which extends dorsally and caudally.

Holotype male, allotype female, and paratype female collected at Carapan, Michoacán (7,500 foot elevation), October 2, 1941. Female paratypes collected at Uruapan, Michoacán (500 feet), October 1941, and Zacapu, Michoacán (7,200 feet), October 4, 1941. All specimens were collected from herbaceous plants by C. C. Plummer, J. S. Caldwell, E. E. Good, and the author.

Texananus vermiculatus DeLong

Texananus vermiculatus DeLong, Ohio Journ. Sci. **38**: 42. 1938.

This species is closely related to and has been confused with *superbus*. Records are at hand

for the states of Sonora and Jalisco and at elevations of 5,000 feet or less. It occurs on grasses in the semidesert.

Texananus superbus (Van Duzee)

Phlepsius superbus Van Duzee, Trans. Amer. Ent. Soc. **18**: 81. 1892.

Three Mexican states along the Gulf coast that are low and have a tropical habitat seem to furnish the ideal conditions for *superbus*. It has been taken in Nuevo León near the Texas border, at El Mante in Tamaulipas, and at Valles in San Luis Potosí. Collecting has not revealed it as occurring in the higher mountain altitudes or on the high plateaus.

Texananus curtus DeLong

Texananus curtus DeLong, Anal. Esc. Nac. Cien. Biol. **1**: 384. 1939.

This species was originally described by the author from a single male specimen from Guerrero. Additional specimens have been collected in the same state at Iguala (2,500 feet). It has also been taken at Tehuantepec, Oaxaca (300 feet), Ixmiguilpan (5,700 feet) and Zimapan (7,800 feet), Hidalgo, and at an elevation of 9,000 feet a few miles west of Mexico City. When this range of elevations is considered, the semidesert habitat seems to be the more important factor determining distribution.

The female has the last ventral segment with posterior margin broadly, roundedly excavated between the produced lateral angles. The entire margin is broadly embrowned.

Allotype female collected at Mexico City, D.F., Mexico (18 km. west), September 1, 1939, by the author.

Texananus uncus, n. sp.

Resembling *curtus* in general form and appearance but smaller, more narrowed, vertex more strongly produced and with different male genitalia. Length male 5.5 mm.

Vertex bluntly angled, about twice as wide between eyes at base as median length.

Color: Vertex pale, mottled with dark brown, a dark brown spot each side on base near eye. Pronotum mottled with brown, a "comma" spot on anterior margin just posterior to each spot on vertex. Scutellum with a spot on base each side on inner margins of basal angles and a pair of round black spots on disk. Elytra pale with dark brown veins and pigment lines, and with three pairs of dark brown spots along commissure of clavus. Face heavily marked with dark brown.

Genitalia: Male plates short, broadly rounded to form blunt apices. Style short, rather broad, apex curved outwardly and rather sharply pointed. Aedeagus with three ventral processes. The lateral ventral processes curve upward and extend just beyond the plates. The central process is shorter, curves upward and is tapered to a sharp pointed apex.

As compared with the male structures of *curtus* it differs especially by having a more produced pygofer, a shorter broader style without a definite finger process at apex and the lateral ventral aedeagus processes are shorter and broader throughout their length, in lateral view.

Holotype male collected just west of Mexico City, D.F., Mexico, at 9,000 feet elevation, September 1, 1939, by the author.

Texananus plummeri DeLong

Texananus plummeri DeLong, Anal. Esc. Nac. Cien. Biol. **1**: 385. 1939.

Texananus cassus DeLong, Anal. Esc. Nac. Cien. Biol. **1**: 385. 1939.

The two species *plummeri* and *cassus* were described by the author from opposite sexes and appeared to be two distinct species. Since a series of both sexes have been collected it is the desire of the writer to retain the male as the holotype of the species and place *cassus* in synonymy, citing the female already described as the allotype.

This species has already been reported for the state of Chiapas. Additional records are Iguala, Guerrero (2,500 feet); Buena Vista, Guerrero (3,400 feet); Acapulco, Guerrero (sea level); Zamora, Michoacán (5,100 feet); and Jiutepec, Morelos (4,900 feet).

Texananus paralus DeLong

Texananus paralus DeLong, Anal. Esc. Nac. Cien. Biol. **1**: 385. 1939.

This has been collected in abundance in several localities and is one of the commonest species of the genus in Mexico. It is now known to occur in Chiapas, Guerrero, Michoacán, and Morelos, ranging in elevation from sea level to 5,000 feet. Although abundant this species has not been found by intensive collecting on the

eastern slope of the Sierra Madre and is apparently a western-slope species.

Texananus conus DeLong

Texananus conus DeLong, Anal. Esc. Nac. Cien. Biol. **1**: 386. 1939.

This species is apparently restricted in its distribution to the southeastern states of Mexico. At present it is known only from the state of Chiapas, and collecting in Oaxaca and Veracruz have failed to reveal it in these areas.

Texananus eugeneus (Ball)

Phlepsius eugeneus Ball, Ann. Ent. Soc. Amer. **11**: 386. 1918.

Collecting has not revealed many specimens of this species, and those obtained were in a rather limited area. In the state of Guerrero it has been taken at several localities ranging in elevation from 1,000 to 6,000 feet. In Morelos it has been taken at 5,000 feet elevation and at a similar elevation in the state of Jalisco. This species is another that would appear to have only a western distribution in Mexico.

Texananus excultus (Uhl)

Phlepsius excultus Uhl, Bull. U. S. Geol. and Geogr. Surv. **3**: 467. 1877.

This is a common species and widely distributed in Mexico. It is already known to occur in Nuevo León, Quintana Roo, Tamaulipas, San Luis Potosí, Michoacán, Jalisco, Sinaloa, Coahuila, Veracruz, and Guerrero. It is more abundant in the low tropical areas but has been collected at elevations of 6,000 feet.

Texananus dorothyi DeLong

Texananus dorothyi DeLong, Anal. Esc. Nac. Cien. Biol. **1**: 387. 1939.

At the time this species was described a single specimen from Pueblo, Mexico, was at hand. More recent collecting has revealed it is a common species in certain of the tropical areas and in the semidesert. It has been collected north of Monterrey in Nuevo León; at Valles, San Luis Potosí; at Jiutepec, Morelos; Tehuantepec, Oaxaca; Zamora, Michoacán; and Iguala, Guerrero. Its distribution ranges in elevation from the low sea-level areas to elevations of 6,000 feet.

Texananus parrai (DeLong)

Phlepsius parrai DeLong, Anal. Esc. Nac. Cien. Biol. **1**: 382. 1939.

This species was described from a single female specimen from Jetla, Guerrero. All additional material collected is from Guerrero and at elevations of 2,500 feet or less. This would indicate that it is a tropical species and lives in the semidesert.

The male resembles the female in form, color, and size. Male plates long, with sides tapering to pointed apices. Pygofer long and narrowed near base, greatly exceeding plates. A heavy fringe of long coarse dark spines borders the ventral margin of the apical half and the dorsal margin of the apical third. Style with a deep concave excavation on outer margin of apical third forming a slender fingerlike process on inner margin which curves outwardly. Aedeagus composed of a single looped process. The basal portion is broad with a pointed process projecting into the concavity. The apical portion is longer, slender, the apex curved dorsally then anteriorly.

Allotype male collected at Iguala (2,500 feet) Guerrero, Mexico, October 25, 1941, by Good and DeLong.

Texananus horridus, n. sp.

Resembling *parrai* in form and appearance but with a shorter vertex and different male and female genitalia. Length 5–5.5 mm.

Vertex short, blunt, scarcely angled, more than one-half as long at middle as basal width between the eyes.

Color similar to *parrai*. The apical area pale with a darker spot each side of apex within the pale area. The central and basal portion heavily mottled with brown and a dark brown spot each side at base near eye. Pronotum and scutellum heavily mottled with brown. Elytra pale with brown veins and rather uniform brownish pigment lines. The three paler lobate spots on clavus along commissure can be recognized but are not as conspicuous as in the *ovatus* group. Face heavily marked with dark brown to black.

Genitalia: Female segment with prominent, produced lateral angles, between which the posterior margin is concavely excavated either side of a pair of rather broad bluntly produced median teeth which are separated by a median

V-shaped notch. The lateral angles are distinctly longer than the median teeth. Male plates long, triangular, about as long as pygofer, convexly rounded to form bluntly pointed tips. Style rather broad at base, abruptly notched on outer margin at four-fifths its length so as to form a rather thick outwardly curved finger-like tip on the inner margin. Aedeagus narrowly U-shaped. The anterior portion of the U is broad, directed dorsally and bluntly pointed at apex. The posterior portion is tapered to form a longer, slender, dorsally directed portion and the apex is not sharp pointed. Pygofer with a row of heavy, thickly set spines which curve inwardly on the dorsal and ventral margins just anterior to apex.

Holotype male, allotype female, and male and female paratypes collected at Acapulco, Guerrero, Mexico (sea level), September 10, 1939, by C. C. Plummer and the author. Male and female paratypes from Iguala, Guerrero, Mexico (2,500 feet), September 11, 1939, collected by Plummer and the author, and October 25, 1941, collected by E. E. Good and the author. Paratypes were collected at Tehuantepec, Oaxaca, Mexico (75 feet), October 13, 1941, by Caldwell, Plummer, Good, and the author.

This species can be separated from *parrai* by the shorter lateral angles of the female segment and the shorter pygofers, the broader, shorter apical tips of the style, and the differently shaped basal portion of the aedeagus in the male.

Texananus incurvatus (Osborn and Lathrop)

Phlepsius incurvatus Osborn and Lathrop, Ann. Ent. Soc. Amer. **16**: 346. 1923.

This species occurs in the southwestern United States, and specimens have been examined from the states of Sonora and Jalisco, Mexico. It has not been taken on the eastern slope.

Texananus hosanus (Ball)

Phlepsius hosanus Ball, Ann. Ent. Soc. Amer. **11**: 386. 1918.

The species has previously been reported for the states of Veracruz, Mexico, Morelos, Guerrero, and Colima. It has proved to be a rather common species and has been taken at several additional localities in the states mentioned and at Jacala, Hidalgo (5,000 feet), Zitacucaro (6,750 feet), Zamora (5,140 feet), Tuxpan (4,000 feet), Carapan (6,000 feet), and Uruapan (5,300 feet) in the state of Michoacán and at Mexico City (7,500 feet) and Río Frío (10,300 feet), D.F. This series of collections shows a range of elevation from 2,500 to 10,300 feet and a range of conditions from semidesert to the luxuriant herbaceous growth of the pine-fir forest. The male has not hitherto been described.

Male plates short, broad, convexly rounded to a rounded inner apical margin. Styles broad, elongate, blunt at apex. Aedeagus in lateral view appearing broad where it joins the connective, then bent upward and narrowed to a caudally directed, sharp-pointed apex. The dorsal portion is narrowed at base, at the apex of which is formed a sicklelike blade which is wide at the base with a produced tooth on the inner basal margin. The apical half is narrow. The open portion of the sickle is dorsal.

Allotype male from Zamora, Michoacán, Mexico, October 2, 1941, collected by Plummer, Good, Caldwell, and the author.

Texananus areolatus (Baker)

Phlepsius areolatus Baker, Can. Ent. **30**: 30. 1898.

This species occurs in prairie habitats in the southern Mississippi Valley and Texas. It undoubtedly occurs at several places along the northern Mexican border, but the only record for Mexico is from Monterrey, Nuevo León. The white areolar spots on the elytra will easily distinguish it from closely related species.

Texananus spatulatus (Van Duzee)

Phlepsius spatulatus Van Duzee, Trans. Amer. Ent. Soc. **19**: 78. 1892.

This is one of the commonest species of the genus in both the southwestern United States and Mexico. Specimens are at hand from the states of Baja California, Nuevo León, Coahuila, Jalisco, Sonora, Tamaulipas, Morelos, Oaxaca, and Guerrero. It occurs in the low desert areas and upon the semideserts to elevations of 5,000 feet.

Texananus biacus DeLong

Texananus biacus DeLong, Anal. Esc. Nac. Cien. Biol. **1**: 389. 1939.

This species was described from a single female specimen from Hermosillo, Sonora. Additional female specimens have been collected at

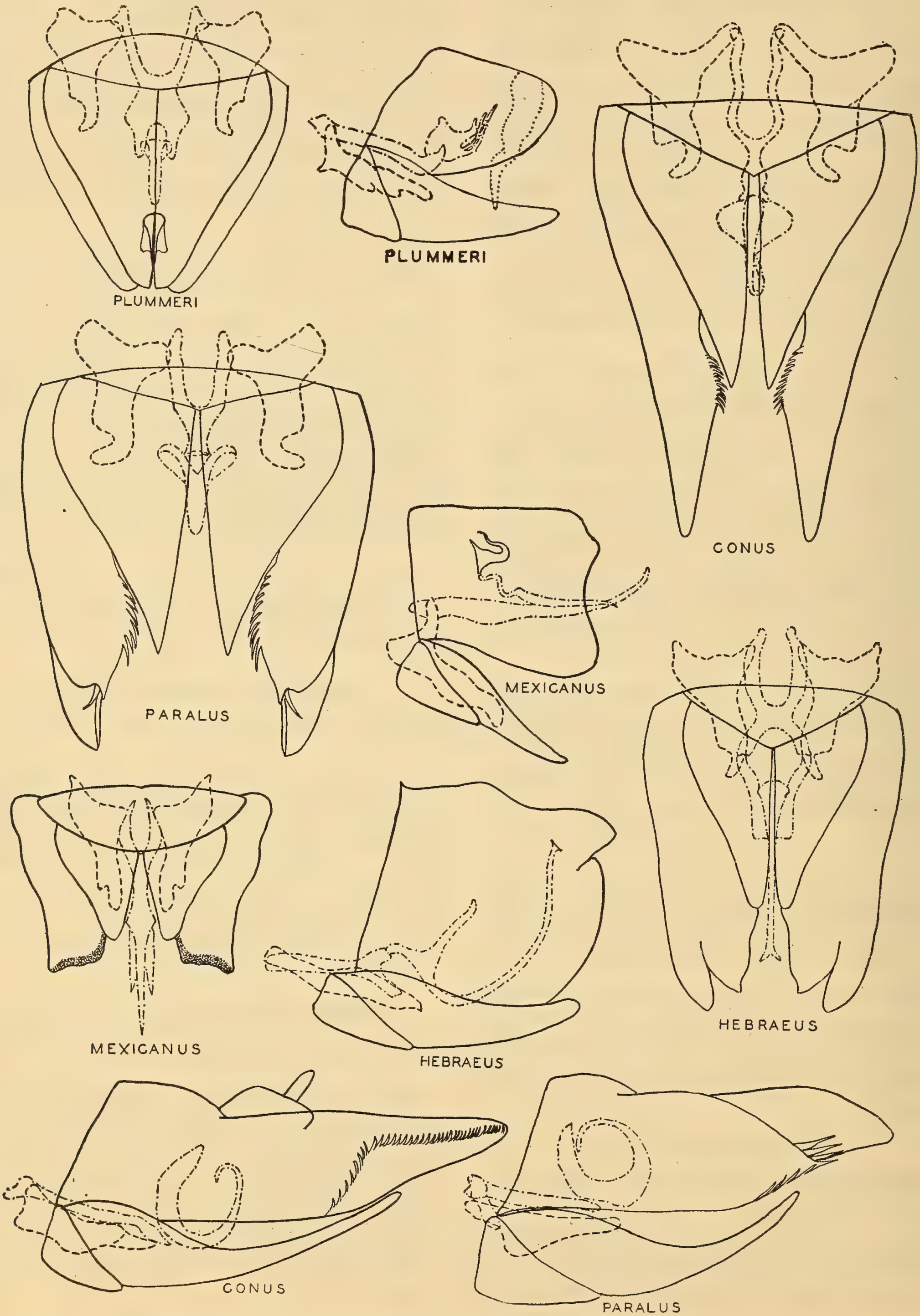

Fig. 3.—Ventral and lateral views of genital structures of species of *Texananus* as labeled.

Mexcala, Guerrero, at an elevation of 1,700 feet No male specimens have been taken.

Texananus mexicanus (Ball)

Phlepsius mexicanus Ball, Ann. Ent. Soc. Amer. **11**: 385. 1918.

Records of previous citations are for Orizaba, Veracruz, and Chilpancingo and Acapulco, Guerrero. Other states are represented by material collected at Zamora (5,100 feet) Zacapu (6,500 feet), Michoacán, and Valles, San Luis Potosí (300 feet). The range in eleva-

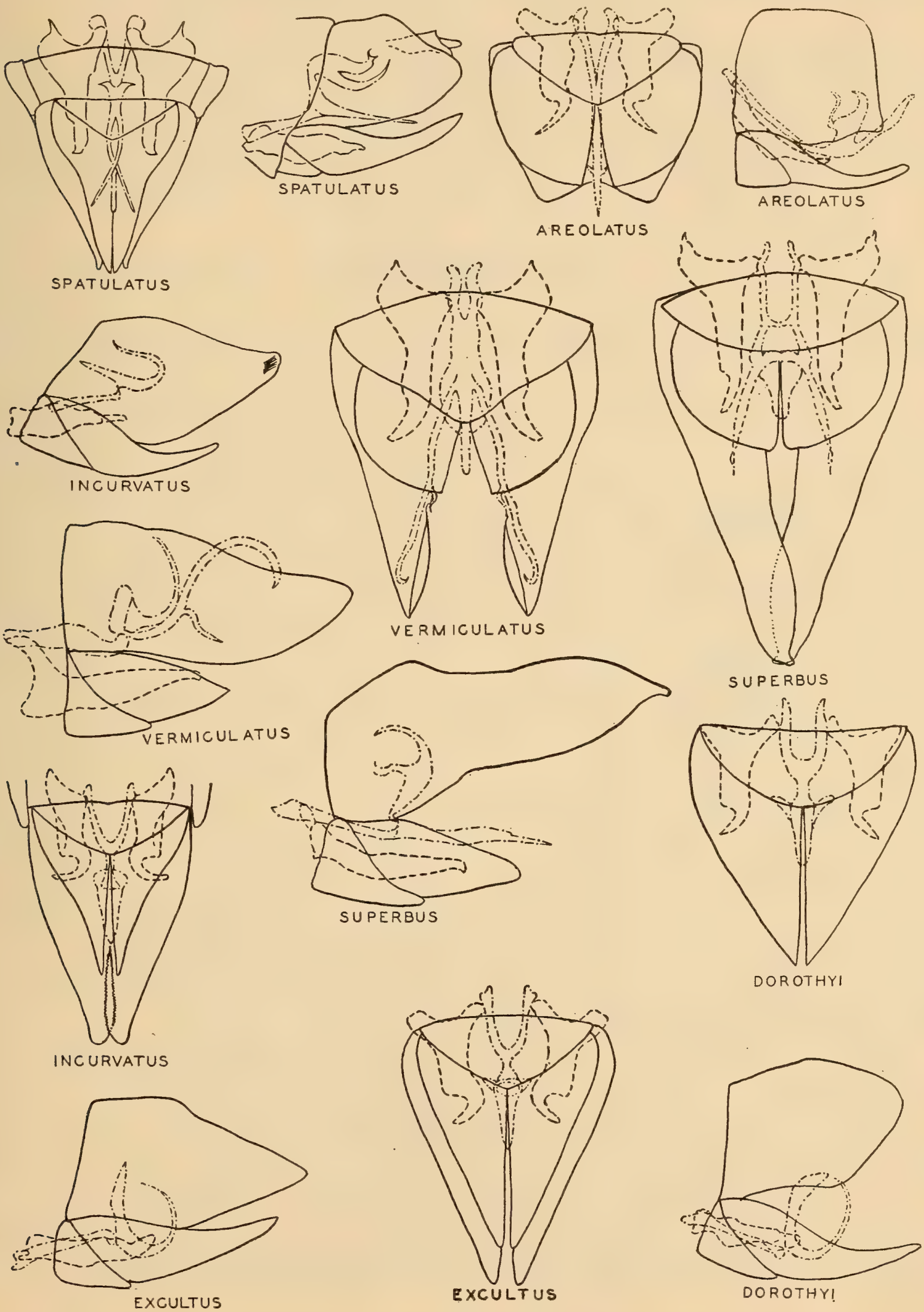

Fig. 4.—Ventral and lateral views of genital structures of species of *Texananus* as labeled.

tion for this species would therefore be from sea level to about 6,500 feet, according to present records.

Texananus elongatus (Ball)

Phlepsius elongatus Ball, Ann. Ent. Soc. Amer. **11**: 382. 1918.

This species is known by the female holotype specimen alone, which was collected at Amula, Guerrero, Mexico.

Texananus handlirshi (Ball)

Phlepsius handlirshi Ball, Ann. Ent. Soc. Amer. **11**: 383. 1918.

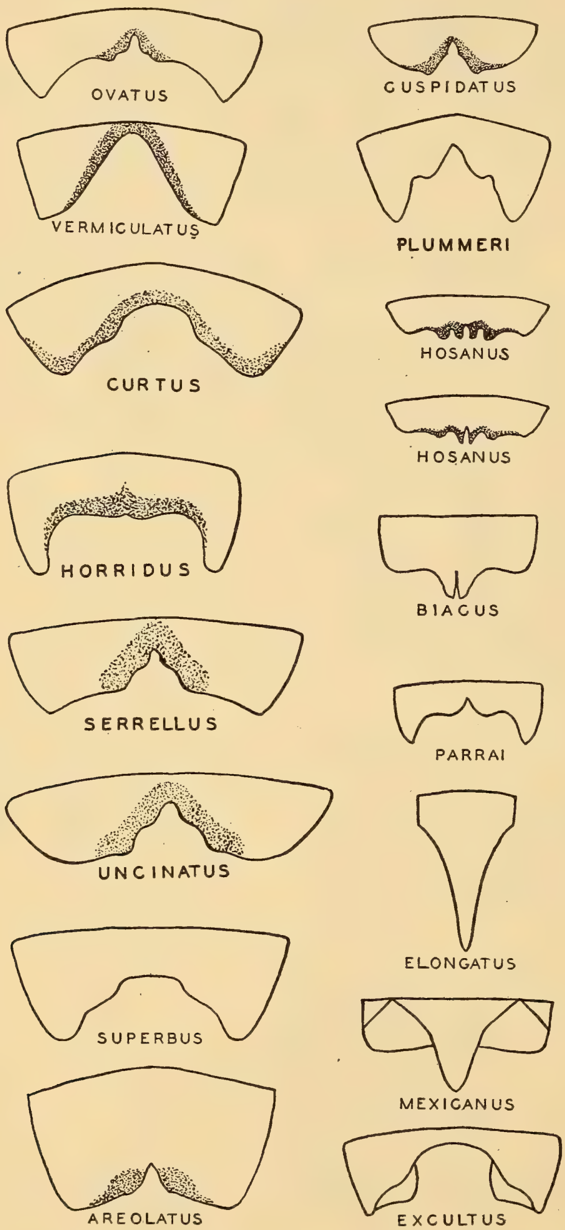

Fig. 5.—Ventral view of last ventral segment of female abdomen of species of *Texananus* as labeled.

In form and appearance this species closely resembles *majestus*. It is known to occur in Mexico, D.F., and in several localities in Guerrero.

Male plates long, broad at base, gradually tapered to bluntly pointed apices. Style broad at base, rapidly, concavely narrowed before middle on outer margin to form a produced, narrow apical half on inner margin, which is pointed at apex. Aedeagus with a ventral and dorsal process. The ventral portion is long, slender, curved dorsally, the apical fourth bent ventrally, and very narrow. The dorsal portion with a pair of dorsal, basal lobes from which a long slender tapering process extends ventrally then curves caudally and extends caudodorsally. It is not as long as ventral portion. Pygofer narrowed, with an apical lobe.

Texananus hebraeus (Ball)

Phlepsius hebraeus Ball, Ann. Ent. Soc. Amer. **11**: 383. 1918.

This large well-marked species is known from only two states by collections made to date. It occurs in Guerrero and in Chiapas at Finca Vergel, in the Río Huixtla Valley. Most of the material was taken at elevations of 2,100 to 3,200 feet.

Obituaries

Edward Wheeler Parker, statistician, conservative, gentleman, was known to the mineral industry, and particularly to the coal industry, for his staunch defense of private enterprise, his scrupulous honesty, and his exactitude in figures and statements, whether public or private. Born in Maryland in 1860, he lived a Southern Gentleman, knowing and practicing courtesy and hospitality. His death occurred on January 3, 1944.

At least a part of his early years, after leaving Baltimore City College, were spent in Texas in newspaper work. He began his Government service on the Census of Mining for 1890 and in 1891 joined the United States Geological Survey as statistician. From 1907 to 1915 he was in charge of the Mineral Resources Branch of the Survey, and in these years he contributed largely to the development of the complete and authoritative annual statistical and descriptive reports of mineral production. It is a tribute to his integrity and an evidence of the confidence he inspired that these statistical records were accumulated from every producer of every mineral on a purely voluntary basis, with no compulsion or threat of penalty. As the administrator of the Mineral Resources Branch of the Survey, he developed statistical procedure and systematic records covering production of all minerals from asbestos to zircon. He specialized on the coal and coke industries and secured the cooperation of the geologists of the Survey as authors of reports on other minerals. His methods and approach to the work of collecting mineral statistics still obtain in the fields that remain in the Survey.

In 1915 Mr. Parker resigned from the Geological Survey to become director of the Anthracite Bureau of Information, at first with headquarters in Wilkes-Barre and later in Philadelphia. He was the common denominator in a small but powerful group where for years there had been no cooperation and much diverse action. When his active participation ended in 1937 the anthracite industry, though less powerful, was by comparison with the previous decade a compact, harmonious group. Parker, by his genial, persuasive personality, his clear thinking, and his steady purpose, was largely responsible for this change.

During his years with the Survey Parker wrote many reports and contributed papers to the magazines and various societies. He was the authority on what the coal industry was doing. In later years he was the quiet man behind the scenes at all anthracite industry wage negotiations, supplying the data and information to his group. Early in his career, in 1900, he was for a short period editor of *Engineering and Mining Journal*. He was a member of a number of societies: the Washington Academy of Sciences, Geological Society of Washington, Washington Society of Engineers, Coal Mining Institute of America, and the Academy of Political Science. He was proud indeed to become a member, in 1940, of the Legion of Honor of the American Institute of Mining

Engineers, after 50 years of continuous service in that organization. When in New York he would most likely be found at the Engineers' Club, in Washington at the Cosmos Club, always among friends. A consistent golfer, he played at Chevy Chase, Merion Cricket, and Westmoreland at Wilkes-Barre.

His appointment by President Theodore Roosevelt, in 1902, to the Anthracite Coal Commission was, to Parker, the greatest honor he received in his long and useful career.

C. E. Lesher.

Arthur Keith, principal geologist in the U. S. Geological Survey for many years and a member of this Academy, died on February 7, 1944. He was a geologist of considerable fame, having been elected president of the Geological Society of America and to membership in the National Academy of Sciences, the highest tribute that can be bestowed on a geologist.

He was descended from a long line of New England stock, his ancestry on his father's side dating back to Rev. James Keith, who settled in Bridgewater, Mass., in 1662, and on his mother's side to Mary Elizabeth Richardson, who settled in Charlestown, Mass., in 1630. Keith was born in St. Louis, Mo., September 30, 1864, but his family moved to Quincy, Mass., when he was an infant. He attended Harvard College and received an A.M. degree in geology in 1886. As a student he actively engaged in college athletics and was an accomplished wrestler and pulled an oar on the Harvard crew. This early athletic training gave him an erect carriage and manly bearing which persisted throughout his later life. In 1916 he married Elizabeth Marye Smith, of Athens, Ohio, whom he survived.

Keith was appointed assistant geologist in the U. S. Geological Survey in the summer of 1887 and was assigned to field duty in the most rugged part of the Appalachians, the Great Smoky Mountains and the Black Mountains culminating in Mount Mitchell. His early work was of a pioneer nature. He traveled the mountain trails by horseback, enduring the hardships of the mountaineers, in whose cabins he spent the nights, often bunking with one of the family. The results of this early field work are embodied in several folios of the Geologic Atlas of the United States. By 1907 he had published 14 folios, each covering an area of about 1,000 square miles. Because the topographic maps of that area were inaccurate in detail, Keith had to devote much time to running traverses, doing triangulation, and resketching the topography, so that he became adept in topographic map making. His geologic field notes consist chiefly of abbreviated descriptive notations on his field maps, so minute that they are clearly readable only with a magnifying lens.

The region in which he worked is one of extremely complicated structure, and it is surprising that he solved so many structural problems, considering the ruggedness and unsettled condition of the region and the large area that he covered in so short a time. His greatest handicap in geologic work was his preference to working out his problems by himself, for he seldom discussed them with other geologists working in adjacent areas.

Between 1907 and 1921, when he was in charge of Areal Geology Surveys of the U. S. Geological Survey, he did little field work. After 1921 he devoted most of his time to the study of earthquakes and geology in New England and eastern Canada and wrote several brief papers on these subjects. He published a geologic map of Maine in 1932. Later he was granted funds by the Geological Society of America to continue his studies of the geology of southeastern Quebec, but unfortunately he was not able to complete his report on this region.

Keith also published numerous geological papers on Appalachian problems, the most outstanding of which were *The outlines of Appalachian structure*, 1923, and *The structural symmetry of North America*, 1927. In the former paper, he propounded the theory that the force that compressed, folded, and faulted the rocks of the Appalachians, causing great earth blocks to be overthrust 50 or more miles, was produced by the intrusion of late Paleozoic granite magmas from a deep-seated source. This hypothesis has not generally been accepted. Keith's greatest contribution to geology undoubtedly is the recording of geologic facts and the interpretation of the geology of the many thousand square miles of the Southern Appalachian Mountains presented in folios of the Geologic Atlas.

George W. Stose.

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CHEMISTRY.—*Polymer chemistry of silicates, borates, and phosphates.*[1]

STERLING B. HENDRICKS, U. S. Bureau of Plant Industry, Soils, and Agricultural Engineering.

Many inorganic compounds can be considered as polymers—as a matter of fact, better understood ones than the more widely known organic examples. Prominent among these are the silicates, knowledge of which was developed from three distinct directions which converged on a single goal. These approaches were through the classifications and factual information of classical mineralogy, through the chemical study of phase equilibria, and through the analysis of crystalline structures by a generation of X-ray workers. The basic principles finally derived are here summarized as a branch of polymer chemistry without the detail of the close view (*A*).[2]

One can not take a comprehensive view of silicates without being aware of phosphates and borates as a contrasting background. Knowledge about phosphates and borates, however, is less developed than for silicates, and this will cause some gaps in the treatment. The general view has brought unknown parts to light, and the way in which explanations have developed for them is a reward of the work.

Relationships of compounds in systems containing only a few components are shown by the familiar phase diagrams, which are the summary of experience guided by the phase rule. It is reasonable to ask, "Why do particular compounds appear?"—a question outside the usual thermodynamics. The answer, which can not yet be fully given, depends in part upon a knowledge of the patterns after which the compounds are built. In the case of silicates, borates, phosphates, vanadates, etc., this is essentially an inquiry about ways in which the elementary groups polymerize to form more extended structures.

The structural element of silicates and phosphates is a tetrahedral grouping of four oxygen ions around a central positive ion as shown in Fig. 2. These groups are joined in polymers by sharing of oxygen ions between two and only two groups as illustrated by the pyrosilicates and metasilicates (Fig. 2). Closed group, chain, sheet, and spacework patterns are built up by repetition of this sharing in a variety of ways, as will be shown. Borates can also have the tetrahedral grouping of four oxygen ions around a central boron ion, but the common structural element is a triangular borate ion, $(BO_3)^{-3}$.

In any polymer of the type to be discussed the extent of polymerization can be indexed by the degree to which oxygen ions are shared between tetrahedral SiO_4 groups. Thus in the pyrosilicate group each silicon ion is surrounded by 4.0 oxygen ions but can be assigned only 3.5 oxygen ions since one is shared. The type of sharing is often, but not necessarily, indicated by the formula.

Phase relationships between silica and a second component with which it can not form copolymers are epitomized in Fig. 1. From the viewpoint of polymerization nothing essentially new is added by further components. While the effects of an ion

[1] Presidential address delivered before the Chemical Society of Washington, January 13, 1944. Received January 31, 1944.

[2] References are to the Appendix at the end of this paper.

such as Al^{+3} that can partially replace Si^{+4} in a group will be neglected, they too can be explained.

Increase in the silica content of a system necessarily results in formation of compounds of increasing degrees of polymerization. With low contents of silica the groups are small as in the ortho-, pyro-, and metasilicates. Metasilicates and compounds richer in silica can be infinite polymers with varieties of forms that will be described. Each polymer is structurally distinct and for this reason generally does not form solid solutions with its neighbors (*B*).

A particular compound can often exist in more than one form. In the ortho-, pyro-, and group metasilicates these forms are merely alternative ways of arranging the groups with respect to the other atoms present. For this reason the transformations are sometimes rapid ones that can be located only by cooling curves. Since metasilicates and higher polymers can form closed groups of varying complexities as well as infinite chains, crystal transitions might involve changes in polymerization. Such changes are chemical reactions and are often very slow. It is for this reason that the quenching technique has generally been used in the study of silicate systems (*B*).

Chain, sheet, and space polymers other than the limiting SiO_2 are subject to considerable breakage upon heating. This is due to their extended forms and as a result lower temperatures are often required for their formation than are necessary for orthosilicates or silica. Formation of two liquids as will later be discussed is also a result of changing polymerization.

Systematic classification of silicate minerals is chiefly determined by types of silicate polymers. Examples of the known types are indicated in Fig. 1. Occurrence of two types of polymers within the same crystal is very rare. It is here illustrated by vesuvianite, which contains both orthosilicate and pyrosilicate groups.

We now turn to consider the detailed structures of the polymers. The SiO_4 group, as previously mentioned, is the basic structural element of all silicate polymers. Its form is shown in several conventional manners in Fig. 2. In this figure the spheres represent ionic centers, the smaller being silicon while the larger is oxygen. Oxygen ions considered as spheres really have about 3.5 times greater diameters than do the silicon ions. They are shown approximately to scale in the second tetrahedral group in Fig. 2 and it is perhaps best to picture the $(SiO_3)_3^{-6}$ group in this way.

Pyrosilicate groups have been observed in the two indicated forms that differ by relative rotations of the constituent SiO_4 groups. Presence of one or the other form depends upon the surroundings in the solid since the energy difference between them is probably small.

Three types of metasilicate groups are shown in Fig. 2. The two $(SiO_3)_4^{-8}$ groups differ in the way in which the silica tetrahedra are placed. While the first of these has not yet been observed as an independent group, it is the polymerizing element in the sheet polymers of the silicates apophyllite and gillespite. The second type with alternating inversion of the SiO_4 tetrahedra has not been observed for silicates but is present in aluminum meta-

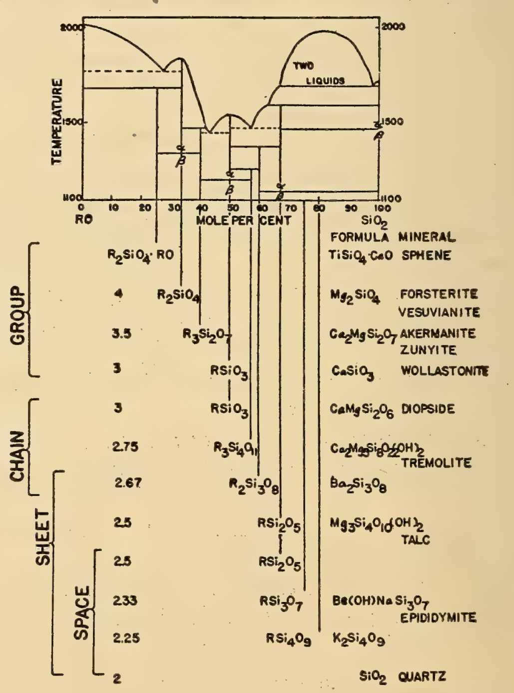

Fig. 1.—A hypothetical diagram showing the types of compounds appearing in a system, RO-SiO_2. Typical minerals corresponding to various stages of silicate polymerization are listed.

phosphate, $Al(PO_3)_3$. The $(SiO_3)_6^{-12}$ metasilicate group, which one might refer to as the hexametasilicate group, is present in the minerals beryl and cordierite. Six membered groups that are elements of sheet and space polymers have two other configurations, one of which is shown in Fig. 2.

Metasilicate compositions can also be given by infinite linear polymers, or $(SiO_3)_N^{-2N}$ chains, which are analogous to the polyisoprene chains of rubber. Solids containing this group have the expected property of forming fibrous masses or masses with lathlike cleavages. Separation of these groups from melts which contain a mixture of less extended forms is a slow process of polymerization in which the catalyst, equivalent to a peroxide for a diene, is the crystal growing from a nucleus.

More elaborate silicate polymers are illustrated by Fig. 3. The upper chain of SiO_4 groups is the chain metasilicate $(SiO_3)_N^{-2N}$, which can be doubled as above the dotted line on the left to form $(Si_4O_{11})_N^{-6N}$ chains of the type that are present in the amphiboles. The $(Si_4O_{11})_N^{-6N}$ chain or double chain, however, could equally well be considered as a polymer in which the pattern element is the 6-silicon ring $(SiO_3)_6^{-12}$ group. Repetition of this group or of the metasilicate chain, as above the line on the right, would lead first to an $(Si_3O_8)_N^{-4N}$ infinite polymer in which one-third of the silicon ions share four oxygen ions with their neighbors and the remaining three oxygen ions. While a polymer of this composition is known, it has an entirely different configuration as will be shown in the later discussion of $Ba_2Si_3O_8$.

The limit of repetition of a polymerizing pattern of the type shown in Fig. 3 would be a sheet polymer with the composition $(Si_4O_{10})_N^{-4N}$. This polymer is observed in some of the micas and clay minerals and it imparts the platy character to these substances. If two such sheets are superimposed into a double sheet then the resulting polymer will be one in which all oxygen ions are shared between silicon ions and the composition will be SiO_2. While none of the known forms of silica has this configuration, it is thought to occur as plates in one of the minerals related to kaolinite (*4*).

An alternative arrangement of the 6-silicon ring $(SiO_3)_6^{-12}$ group or of the metasilicate chain can be considered as the structural element in the tridymite form of silica. Repetition of the polymerizing element leads to complete space filling and we thus see the prototype for cross linking in organic polymers. Space filling is accomplished in other ways in the two other crystalline modifications of silica which will not be discussed here.

The known $(Si_3O_8)_N^{-4N}$ polymer which

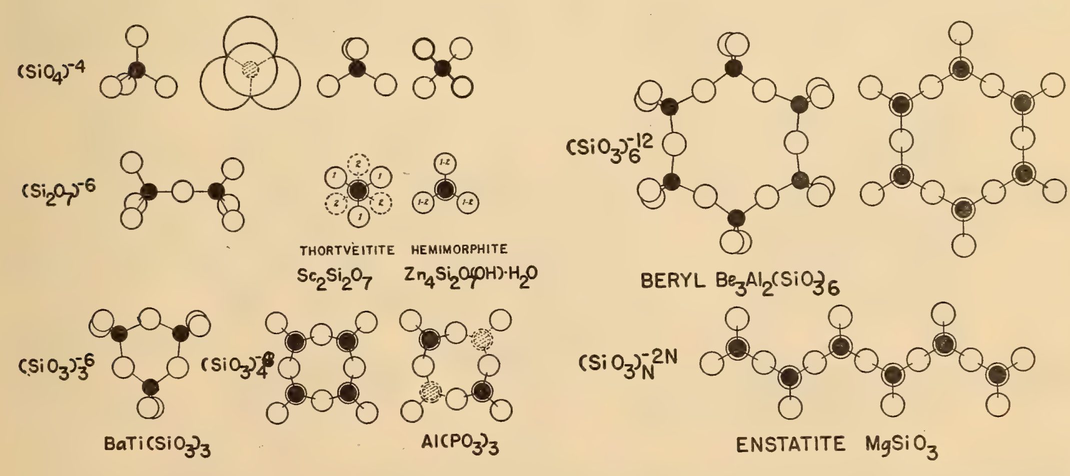

Fig. 2.—Configurations of some silicate groups. The tetrahedral $(SiO_4)^{-4}$ group is shown in the several different ways that will be followed in the various figures.

might have been formed with $(SiO_3)_6^{-12}$ as a structural element really is built up in a different way as shown in Fig. 4 (*5*). The pattern element might be looked upon either as an $(SiO_3)_4^{-8}$ group or a new configuration of the $(SiO_3)_N^{-2N}$ infinite chain. Continuation of this type of pattern leads to a sheetlike structure of the composition SiO_2. Such a form of silica, however, has not been observed.

A continuation of the $(Si_3O_8)_N^{-4N}$ polymer in which the infinite $(Si_3O_8)_N^{-4N}$ multiple chain can be considered as the pattern element is present in the mineral epididymite. This polymer is formed by sharing of the oxygen ions on the upper edge of one $(Si_3O_8)_N^{-4N}$ chain with those on a lower edge of another chain as shown in Fig. 4, *a*. The final composition is $(Si_3O_7)_N^{-2N}$.

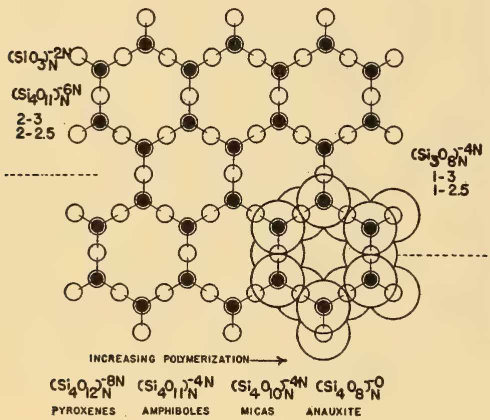

Fig. 3.—Polymerization pattern with a ring of six silica tetrahedra as the pattern element.

One of the distinctive properties of silicate systems is the general absence of solid solutions between compounds having different polymerization indices. Eskola, however, in his study of the system $BaO\text{-}SiO_2$ (*6*), found an exception to this rule in the formation of a complete series of solid solutions between $Ba_2Si_3O_8$ and $Ba_2Si_4O_{10}$. These solid solutions apparently result from the union of $(Si_3O_8)_N^{-4N}$ chains through the addition of SiO_2 as shown in Fig. 4, *b* (*C*). In a sense this is copolymerization of $(Si_3O_8)_N^{-4N}$ chains and SiO_2 leading to a sheet polymer having the composition $(Si_4O_{10})_N^{-4N}$ which can alternatively be reached after the pattern of Fig. 3 and in several other ways by $(P_2O_5)_N^0$ and $(V_2O_5)_N^0$.

The mineral gillespite, $BaFe\,Si_4O_{10}$, which might be expected to have a structural resemblance to $Ba_2Si_4O_{10}$, contains an entirely different type of polymer (*7*). It is formed by repetition of an $(SiO_3)_4^{-8}$ element, but one having a different configuration from that present in Fig. 4. The element and the structural pattern of the $(Si_4O_{10})_N^{-4N}$ polymer is similar to that of apophyllite.

In the end it seems that silicate polymers have a preference for four and six SiO_4 membered rings as polymer elements. Since this is general, it would appear in part to be determined by factors other than the surroundings in a specific solid and might be due to the considerable concentration of the pattern elements in the melt. It is not much better than a guess to point out that the more condensed polysilicates are formed

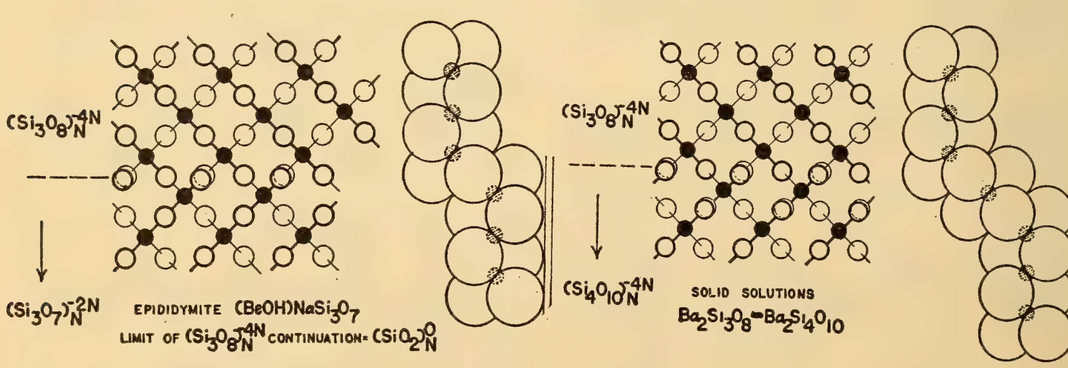

Fig. 4.—(*a*) The polymerization pattern of $(Si_3O_7)_N^{-2N}$ in which $(Si_3O_8)_N^{-4N}$ chains can be considered as the pattern element; (*b*) A diagram illustrating the probable way in which SiO_2 is added to the $(Si_3O_8)_N^{-4N}$ chains of $Ba_2Si_3O_8$ to give the sheet polymer $(Si_4O_{10})_N^{-4N}$ of $Ba_2Si_4O_{10}$.

through the intermediary of preformed metasilicate rings or ring fragments. The polymer pattern in a particular case is surely dependent upon the entire structure of the crystal, a factor that will not be considered here.

Let us now contrast the polymerization patterns of borates and silicates. Borate patterns are necessarily modified by the planar structure of the $(BO_3)^{-3}$ ion which is illustrated in Fig. 5. The B-O distance, 1.35A, is about 0.30A smaller than the Si-O distance and this changes the manner in which oxygen ions of neighboring groups pack sufficiently to modify extended patterns. This effect is well illustrated by the $(BO_2)_N^{-N}$ chain which is contrasted with the corresponding $(SiO_3)_N^{-2N}$ chain in Fig. 5.

Ortho-, pyro-, and tri-metaborate groups, shown in Fig. 5, are closely similar to the corresponding silicate groups. The hexametaborate ion $(BO_2)_6^{-6}$ would be expected to have the configuration of the polymer element of the hypothetical $(B_6O_{11})_N^{-4N}$ chain of Fig. 5. This should be contrasted with the corresponding $(SiO_3)_6^{-12}$ groups of Fig. 2. The $(BO_2)_4^{-4}$ ion shown in Fig. 5 might at first sight appear closely similar to a possible $(SiO_3)_4^{-8}$ metasilicate group, but it is particularly affected by repulsion of oxygen ions across the center of the group.

Polyborate polymers more condensed than the metaborate might be expected to make use of some of these ring metaborate groups as pattern elements. Thus the $(BO_2)_6^{-6}$ metaborate group could be condensed rather strictly after the pattern of the $(SiO_3)_6^{-12}$ group as shown in Fig. 3, giving rise to $(B_4O_7)_N^{-2N}$ and $(B_3O_5)_N^{-N}$ chains, and, in the limit, to $(B_2O_3)_N^0$ sheets. The first of these might be expected to appear in borax, the so-called sodium tetraborate decahydrate, and the last could be a modification of boric oxide. Intermediate members could be represented among the polyborates that are present in the Alkali Oxide–B_2O_3 systems.

The tetraborate group $(BO_2)_4^{-4}$ group illustrated in Fig. 5 could not be a simple pattern element as any linoleum designer could readily see. Thus whatever might be the nature of polyborates, they cannot make any great use of a four (BO_3) membered element of pattern in contrast to polysilicates in which the four membered element is commonly used.

While the structure of none of the polyborates is known, their properties can serve as a guide for further discussion. Many of the anhydrous ones form relatively quickly from melts, lack distinctive cleavages, and readily dissolve in water. These are definitely properties of limited groups rather than of sheet and chain polymers.

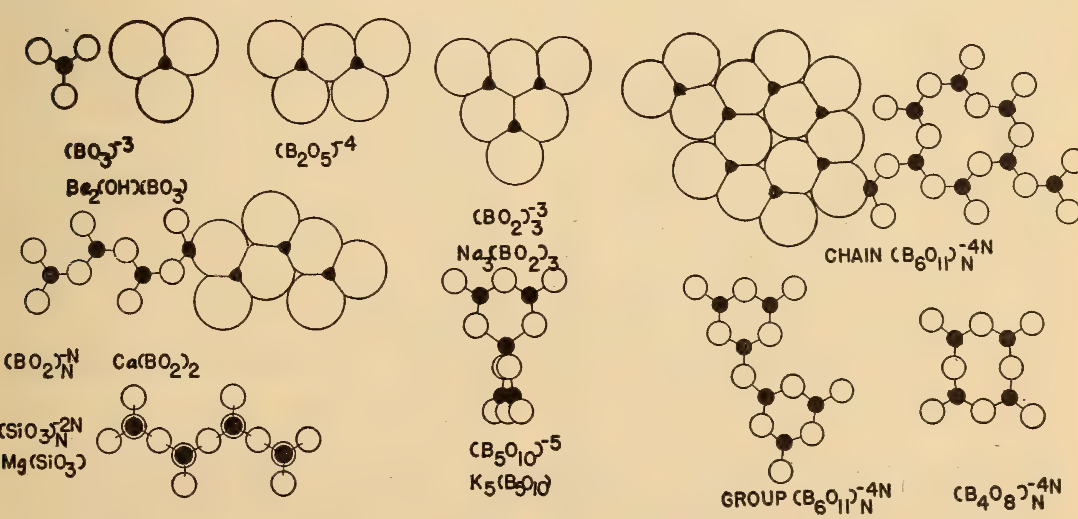

Fig. 5.—Possible pattern elements of some ortho-, pyro-, meta-, and poly-borates. These are to be compared with the silicate groups in Fig. 2.

What might be the structures of such polyborate groups, and why are they not exhibited by polysilicates?

The $(B_6O_{11})_N^{-4N}$ polymer which is represented by compounds such as $Cd_2B_6O_{11}$ and which, of all the polyborates, approaches most closely to the metaborate composition might be considered first. It could be an infinite chain as shown in Fig. 5. However, it could be more simply formed from two $(BO_2)_3^{-3}$ groups as also shown in this figure. Sharing of the other two oxygen ions of one $(BO_2)_3^{-3}$ group by $(BO_2)_3^{-3}$ groups would give a $(B_{12}O_{21})^{-6}$ group or more simply the tetraborate, $(B_4O_7)^{-2}$. It is seen that a structural element of these condensed groups is the tri-metaborate group, $(BO_2)_3^{-3}$. Addition of a third tri-metaborate group to the $(B_6O_{11})_N^{-4N}$ group shown in Fig. 5 to form a 6-B membered ring would give a group having the composition $(B_9O_{15})^{-3}$ or $(B_3O_5)^{-1}$. Other possibilities are shown in Table 1. The matter is not pressed further since it is easy to fall into artificiality and thus obscure the essentially correct features.

Most naturally occurring borates formed from aqueous solutions and are often hydrates (*8*). Their behavior is illustrated by the sodium salts borax, tincalconite and kernite, the first and last of which are the most important ores of boron. Borax and tincalconite are readily soluble in water. The monoclinic unit of structure of borax has been measured and shown to contain 16 boron atoms (*9*). If condensed groups are present in borax, they must contain 4 boron ions and for this reason are acid metaborates instead of polyborates as the formulas might suggest. The group in borax is thus $(B_4O_6(OH)_2)^{-2}$. Most of the early attempts to prepare kernite rather gave the pentahydrate, tincalconite (*8a*). Easy formation of tincalconite apparently is due to its containing a simple acid metaborate group having either four or six boron atoms. Kernite, on the other hand, is quite insoluble in water and has the perfect lathlike cleavage required by a linear polymer. However, it is doubtful that it is a polyborate chain polymer of the composition $(B_4O_7)_N^{-2N}$ but rather is an acid metaborate chain $(B_4O_6(OH)_2)_N^{-2N}$. (*D*)

The tendency for condensed borates in aqueous systems to be limited to the metaborate stage of polymerization is shown by the system H_2O–B_2O_3 in which metaboric acid is the most condensed polymer (*10*). Metaboric acid, as shown by Morey, Kracek, and Merwin, of the Geophysical Laboratory, exists in three forms the properties of which suggest that they contain group rather than chain polymers. One of these modifications holds an interesting key for us.

Boron trioxide is of particular interest in that it was one of the most difficult inorganic compounds to crystallize. Crystallization was first independently accomplished about seven years ago by McCulloch(*11*) and by Morey, Kracek, and Merwin (*10*). At first consideration it would appear that B_2O_3 would have to be a sheet type polymer since there is no very apparent way to obtain cross linking in space with $(BO_3)^{-3}$ as the simplest element.

Morey, Kracek, and Merwin showed that B_2O_3 crystallizes only in the presence of the most stable form of metaboric acid. This form is cubic and the unit of structure contains 24, HBO_2 (*10*). From these few facts alone it is possible to obtain the essential details of the HBO_2-I structure and some suggestions about the polymerization pattern of B_2O_3. The metaborate groups in HBO_2-I must contain 3, 4, or 6 boron atoms and must be associated through hydrogen bonding. A structure of the required type is shown in Fig. 6,*a*. $(HBO_2)_3^0$ groups are present, and these have their planes perpendicular to three fold axes. Three $(HBO_2)_3^0$ groups are joined by hydrogen bonding around three fold axes. The three hydrogen bonds can be replaced by boron ions on the three fold axes. The resulting B_2O_3 can be considered as made up of tri-metaborate groups copolymerized in space through $(BO_3)^{-3}$ groups (*E*).

Finally it should be recalled that boron sometimes is surrounded at the corners of tetrahedron by four oxygen ions in a manner similar to silicon. This is shown by the pentaborate ion $(BO_2)_5^{-5}$ illustrated in Fig. 5. It is best exhibited by BPO_4 and the silicate mineral danburite, $CaB_2Si_2O_8$. The former has a structure similar to the high

temperature cristobalite modification of SiO_2 and the latter is also a space type polymer.

We now turn briefly to consider the polymer chemistry of sulphates and phosphates. The first holds little of interest since it is restricted to the neutral meta-stage, which, however, is represented both by group and linear polymers of SO_3. Phosphates might be expected to parallel silicates closely in their ways of condensation. They fail in this respect for several reasons, chief among which is the different requirement of the electrostatic valence principle due to the increased charge of phosphorus and the increased tendency to form covalent bonds (*F*). For these reasons polyphosphates are not expected to form from aqueous systems at low temperatures without some source of energy, silica can crystallize as quartz in the presence of water with which P_2O_5 reacts violently.

Phosphorus pentoxide is equivalent to $(Si_2O_6)_N^{-2N}$, which was found to polymerize in sheets according to three different patterns. If $(P_2O_5)_N^0$ and $(V_2O_5)_N^0$ are considered they are found to represent group, sheet, and space polymers. (*12*) These are illustrated in Fig. 6,*b*. A main structural principle in these polymers is the necessity for the unshared oxygen ion to approach a P or V ion to satisfy the electrostatic valence principle. This requirement operates to destroy possible highly symmetrical polymer patterns similar to these discussed for polysilicates.

Very little structural information is available on polyphosphates, and this is equally true for equilibrium data. In fact, the only binary system on which reasonably complete data are available is the system CaO-P_2O_5 on which Mr. Hill and Mr. Reynolds of the Fertilizer Division and Dr. Faust formerly of that Division have been working (*13*). Some of the compounds observed are shown in Table 3. The polyphosphates $Ca_2P_6O_{17}$ and CaP_4O_{11} might be expected to have structures similar to the hypothetical $(B_6O_{11})_N^{-4N}$ chain polymer and the $(Si_4O_{11})_N^{-6N}$ chain polymer of the amphiboles. The very little information available on the crystals, chiefly absence of lathlike cleavages, however, indicates a group polymerization.

Polyphosphate group polymers could, as a matter of fact, follow analogous patterns to some of the polyborate group polymers previously discussed. Thus $(P_6O_{17})^{-4}$ could be formed by sharing of one oxygen ion between two $(PO_3)_3^{-3}$ trimetaphosphate groups equivalent to the $(B_6O_{11})^{-4}$ group polymer of Fig. 5, and the $(P_4O_{11})_N^{-2N}$ group poly-

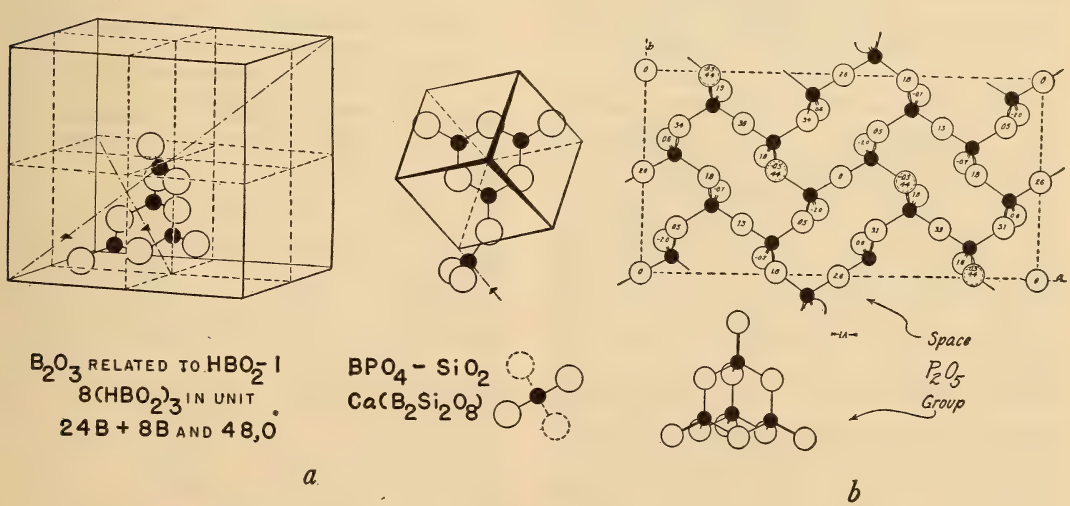

Fig. 6.—(*a*) A schematic illustration of the possible structural relationship of crystalline B_2O_3 and cubic metaboric acid. The tetrahedral grouping of oxygen ions around boron as observed in a few compounds is also shown; (*b*) The polymerization patterns of the orthorhomic and cubic modifications of P_2O_5. Distances in A units from the plane of the projection are indicated on the drawing.

mer could be formed from four $(PO_3)_3^{-3}$ groups. However, these group polymers can also be obtained in another manner which was not possible for polyborates. This would make use of the $(PO\ )_4^{-4}$ element, $(P_6O_{17})^{-4}$ combining two of these elements and $(P_4O_{11})_N^{-2N}$ three of them.

Phosphates exhibit one property to an apparently greater extent than do silicates, namely the formation of compounds intermediate between the pyro- and meta-degree of polymerization. These must be open or branch chains, and the best example is afforded by the silicate zunyite which Pauling found to contain $Si_5O_{16}^{-12}$ groups. The central SiO_4 group shares each of its oxygen ions with neighboring groups. An analogous compound is probably present in the CaO–P_2O_5 system, the formula being $(P_5O_{16})^{-7}$. The greatly decreased charge relative to $(Si_5O_{16})^{-12}$ apparently operates to stabilize the polymer in the crystal. Similarly the group $(P_3O_{10})^{-5}$ polymer is present in the Na_2O–P_2O_5 system (*14*).

These groups intermediate between pyro- and metaphosphates, the di- and tri- PO_4 group polymers, have immense biological importance for it is through their formation in conjugation with the purine bases that energy is stored or released in small steps in carbohydrate utilization (*15*). Thus while polysilicates will form from dilute aqueous systems, polyphosphates will liberate of the order of 20,000 calories of energy upon hydrolysis for each PO_4 ion formed.

Finally it is worth while to consider liquid immiscibility in silicate and borate systems (*16*) from the view point of polymerization. Four essentially distinct types of systems occur. Liquid immiscibility has been observed only for SiO_2 or B_2O_3 rich mixtures with Mg, Ca, Sr, Fe, Zn, Ni, or Co oxides. The two liquids appear with increasing silica content near the composition required for sheet polymers $(Si_2O_5)_N^{-2N}$. In the B_2O_3–RO systems they appear where group borates have attained about the complexity of $(B_3O_5)_N^{-N}$. Liquid immiscibility is not observed in three distinct types of systems, namely: (1) When the components copolymerize, e.g., SiO_2–B_2O_3, SiO_2–Al_2O_3; (2) where a compound of very high melting point can remove small groups from the melt, e.g., ZrO_2–SiO_2, SnO_2–B_2O_3; (3) where the liquidus temperature is sufficiently reduced to permit crystallization of sheet and other complex polymers, e.g., K_2O–SiO_2, Li_2O–B_2O_3.

Liquid immiscibility then in silicate systems appears to result from mutual insolubility of space and sheet polymers arising from their greatly different configurations (*G*). The space polymer, high cristobalite, however, crystallizes best from the liquid of lower silica content possibly due to a continuous supply of small groups to the nucleated points. Viscosity is correlated with the type of polymerization but probably is not determinative for crystallization as is so often implied; it is a symptom, not a disease.

The form of B_2O_3 in the limit of B_2O_3–RO melts is probably not similar to the crystalline B_2O_3 related to HBO_2(I), but rather is a more random spatial array. Two liquids appear upon increasing B_2O_3 contents of the systems when groups become sufficiently complicated to have serious entropy factors operating against their elaboration compared with their copolymerization. In other words it is easier for groups to combine with each other than to build up gradually in more and more complicated ways.

It would have been difficult to follow in

TABLE 1.—POSSIBLE ELEMENTS IN POLYMERIZATION PATTERNS OF POLYBORATES

Composition	Boron-oxygen sharing	Boron atoms in chain element	Multiplicity and group
$(B_2O_4)_N^{-2N}$	2–2	1	1×3; 1×4; 1×6; 2×3 B_3O_6; B_4O_8; B_6O_{12}; B_5O_{10}
$(B_6O_{11})_N^{-4N}$	4–2 2–1.5	6	2×3; 3×4; 4×6 B_6O_{11}; $B_{12}O_{22}$; $B_{18}O_{33}$
$(B_4O_7)_N^{-2N}$	2–2 2–1.5	6; 4	4×3; (1×2)+(2×3) $B_{12}O_{21}$ B_8O_{14}
$(B_6O_{10})_N^{-2N}$	2–2 4–1.5	6; 3	3×3 B_9O_{15}
$(B_8O_{13})_N^{-2N}$	2–2 6–1.5	6	(1×4)+(4×3) $B_{16}O_{26}$
$(B_{10}O_{16})_N^{-2N}$	2–2 8–1.5		
$(B_2O_3)_N^0$	2–1.5		

TABLE 2.—POLYMERIZATION IN SOME POLYBORATE MINERALS

Compound	Mineral	Acid metaborate structural element	Probable value of N
$Na_2O \cdot 2B_2O_3 \cdot 10H_2O$	Borax	$(B_4O_6(OH)_2)_N^{-2N}$ Group	1
$Na_2O \cdot 2B_2O_3 \cdot 5H_2O$	Tincalconite	$(B_4O_6(OH)_2)_N^{-2N}$ Group	1 or 1.5
$Na_2O \cdot 2B_2O_3 \cdot 4H_2O$	Kernite	$(B_4O_6(OH)_2)_N^{-2N}$ Chain	
$(NH_4)_2O \cdot 5B_2O_3 5H_2O$	Larderellite	$(B_4O_5(OH)_3)_N^{-N}$ Group	

such a short time the details of the many patterns, the fine points of the various arguments, and the unelaborated implications. Interest and incentive of those who played prominent parts in the development of this subject when it was hot have passed to other fields or have been subdued by pragmatism. Since the many unanswered questions have no immediate hope of attention it seemed best to attempt some synthesis of answers. The final truth of the matter, however, is that the unrequited labor of many workers will be required to clarify the chemistry of phosphates and borates.

TABLE 3.—POLYMERIZATION OF PHOSPHATES AND SULPHATES

Known compounds in $CaO–P_2O_5$ system	Possible polymer type	Group composition	Oxygen sharing	Compound
$Ca_3(PO_4)_2 \cdot CaO$		$(PO_4)^{-3}$		
$Ca_3(PO_4)_2$	Group	$(PO_4)^{-3}$	4.0	$CaSO_4$
$Ca_2(P_2O_7)$		$(P_2O_7)^{-4}$	3.50	CaS_2O_7
$Ca(PO_3)_2$		$(PO_3)_n^{-n}$	3.0	$(SO_3)_n$
		$(PO_3)_N^{-N}$	3.0	$(SO_3)_N$
$Ca_2(P_6O_{17})$	Chain	$(P_6O_{17})_N^{-4N}$	2.833	
$Ca(P_4O_{11})$		$(P_4O_{11})_N^{-2N}$	2.75	
P_2O_5	Space	$(P_2O_5)_N^0$	2.50	

SUMMARY

Patterns after which silicate groups combine to form polymerized polysilicates are illustrated. Influences of polymerization patterns on phase equilibria are discussed. Structural features of polyborates, phosphates, and sulphates are contrasted with those of silicates.

An explanation is advanced for the formation of solid solutions between $Ba_2Si_4O_{10}$ and $Ba_2Si_4O_{10}$. Probable types of group structures in some hydrous polyborates are indicated and a possible structural relationship of HBO_2–I and crystalline B_2O_3 is pointed out. An explanation is given for the observed liquid immiscibility in silicate and borate systems.

APPENDIX

A. *References*

Discussions and references to the original literature for the many structures upon which this work is based will be found in:

(*1*) W. L. BRAGG, *Atomic structure of minerals*, Ithaca, 1937.

(*2*) Zeit. Krist. "Strukturbericht," Leipzig, 1931 et seq.

Pertinent phase equilibrium diagrams are summarized by:

(*3*) F. P. HALL and H. INSLEY, *Compilation of phase rule diagrams of interest to the ceramist and silicate technologist*, Journ. Amer. Ceramic Soc. **16**: 459, 1933; **21**: 113, 1938.

Other references and the subjects concerned, not the titles of the papers, are:

(*4*) Possible structure of anauxite, S. B. HENDRICKS, Journ. Geol. **50**: 276, 1942.

(*5*) Crystal structure of epididymite, T. ITO, Zeit. Krist. **88**: 142, 1934.

(*6*) Phase equilibrium data for the system $BaO-SiO_2$, P. ESKOLA, Amer. Journ. Sci. (5)**4**: 331, 1922.

(*7*) Crystal structure of gillespite, A. PABST, Amer. Min. **28**: 372, 1943.

(*8*) Discussions of the mineralogy of borates by W. T. SCHALLER: (*a*) U. S. Geol. Surv. Prof. Pap. 158–I, 1929; (*b*) Amer. Min. **27**: 467, 1942.

(*9*) Space group determinations for hydrates of sodium tetraborate: (*a*) W. MINDER, Zeit. Krist. (A) **92**, 301, 1935; (*b*) J. GARRIDO, Anal. Españ. Fis. y Quim. **30**: 91, 1932; Zeit. Krist. **82**: 468, 1932.

(*10*) Phase equilibrium data for the system $H_2O-B_2O_3$, F. C. KRACEK, G. W. MOREY, and H. E. MERWIN, Amer. Journ. Sci. (5)**35–A**: 143, 1938.

(*11*) Crystallization of B_2O_3, (*10*) above and L. MCCULLOCH, Journ. Amer. Chem. Soc. **59**: 2650, 1937.

(*12*) Crystal structure of the various modifications of P_2O_5, H. C. J. DE DECKER and C. H. MACGILLAVRY, Rec. Trav. Chim. **60**: 153, 1941; **60**: 413, 1941.

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$CaO\text{-}P_2O_5$, W. L. HILL, G. T. FAUST, D. S. REYNOLDS, Amer. Journ. Sci. (in press).

(*14*) Phase equilibrium data for the system $Na_2O\text{-}P_2O_5$, E. P. PARTRIDGE, V. HICKS, and G. W. SMITH, Journ. Amer. Chem. Soc. **63**: 454, 1941.

(*15*) References to biological formation of di- and tri-phosphates, K. LOHMANN, Ann. Rev. Biochem. **27**: 125, 1938.

(*16*) Liquid immiscibility in silicate and borate melts: (*a*) J. W. GREIG, Amer. Journ. Sci. (5)**13**: 1, 133, 1927; (*b*) W. GUERTLER, Zeit. Anorg. Chem. **40**: 225, 1904.

(*B*). *Solid Solutions: Rapidity of Polymorphic Transitions*

Formation of solid solutions between compounds having the same degree of group polymerization is common among silicates and is an important factor in mineralogy. Mg_2SiO_4 and Fe_2SiO_4, for instance, form a complete series of solid solutions (the forsterite-fayalite series) and $MgSiO_3$ forms limited solid solutions with $FeSiO_3$, but the metasilicate and orthosilicates are mutually insoluble (N. L. BOWEN and J. F. SCHAIRER, Amer. Journ. Sci. (5)**29**: 151, 1935.) Solid solutions of this type are thought to be limited by the relative sizes of the varying ions (Mg^{+2} and Fe^{+2}) and by possible appearance of new phases due to the changing temperature of the liquidus.

Solid solutions reported to occur about $CaSiO_3$ in the system $CaO\text{-}SiO_2$ and between alkali silicates having different degrees of polymerization have not been found upon further work.

Excellent examples of the varying rates of polymorphic transitions dependent upon the degree of polymerization are afforded by the system $NaPO_3\text{-}Na_4P_2O_7$ (E. P. PARTRIDGE, V. HICKS, and G. W. SMITH, Journ. Amer. Chem. Soc. **63**: 454, 1941. Four rapid transitions were observed between five crystalline forms of the simple group pyrophosphate. Transitions between the three forms of the metaphosphate, which probably vary in their polymer patterns, were all sufficiently slow to allow ready quenching.

Transitions taking place without change in polymerization might be slow since the restraints of the solid need not readily permit rearrangement of groups in the absence of a liquid phase.

(*C*). *Structural Considerations for Solid Solutions between $Ba_2Si_3O_8$ and $Ba_2Si_4O_{10}$*

The mineral sanbornite has been described by A. F. ROGERS (Amer. Min. **17**: 161, 1932). It is possibly triclinic and closely approximates $Ba_2Si_4O_{10}$ in composition. The one perfect cleavage gives it micaceous characteristics. Eskola (*6*) gave the following properties for $Ba_2Si_3O_8$ and $Ba_2Si_4O_{10}$ prepared from melts:

$Ba_2Si_3O_8 N_D\alpha = 1.597$	$Ba_2Si_4O_{10} N_D\alpha = 1.620$
$\beta = 1.612$	$\beta = 1.625$
$\gamma = 1.621$	$\gamma = 1.645$
Density = 3.73	Density = 3.93

The almost perfect cleavage is parallel to the plane $\alpha\beta$. Two other poorly developed pinacoidal cleavages are present in $Ba_2Si_3O_8$ crystals. Pabst (*7*) noted that the X-ray powder diffraction pattern of natural sanbornite is unrelated to that of gillespite, $BaFeSi_4O_{10}$, which is somewhat similar to apophyllite in its polymerization pattern (7).

The molecular volume of $Ba_2Si_4O_{10}$ is only about 9 percent greater than that of $Ba_2Si_3O_8$ which would correspond to an average increase of 2 percent in lattice dimensions. This is a very small change and shows that SiO_2 added to $Ba_2Si_3O_8$ goes into an essentially vacant position. Calculated and observed molecular refractivities are in agreement as required;

Compound	*Molecular Refractivity* Observed	Calculated
$Ba_2Si_3O_8$	44.1	43.2
$Ba_2Si_4O_{10}$	50.9	51.5

Observed values were obtained from the average refractive index and calculated values by use of the following ionic refractivities $Ba^{++} = 5.30$, $O^{--} = 3.85$, and $Si^{+4} = 0.60$.

The suggested structure is in harmony with the above observations. It can most readily be checked by determining the lattice periodicities in the cleavage plane, one of which should be that required by an $(Si_3O_8)_N^{-4N}$ chain pattern element.

(*D*). *Structural Information on Hydrates of Sodium Tetraborate*

Borax.—$Na_2B_4O_7 \cdot 10H_2O$, monoclinic holohedral space group $C_{2h}^6 - C2/c$ (*9*).

Unit of structure, contains $4[Na_2B_4O_7 \cdot 10H_2O]$

$a = 11.82A$	$c = 12.30A$
$b = 10.61A$	$\beta = 106°35'$

Perfect cleavage parallel to (100), poor parallel to (110), and (010). Quickly dissolves to limit of solubility. Loses approximately $1H_2O$ between 150° and 500°C.

These observations require the presence of $[B_4O_6(OH)_2]^{-2}$ groups with the minimum symmetry of $C_i - \bar{1}$.

Tincalconite.—$Na_2B_4O_7 \cdot 5H_2O$, rhombohedral space group $C_{3i}^2 - R\bar{3}$ (*9*).

Unit of structure, contains $3[Na_2B_4O_7 \cdot 5H_2O]$

$a = 9.56$	$\alpha = 71°42'$

No pronounced cleavage. Quickly dissolves to limit of solubility.

Loses 16 percent of total water above 200° (*8a*).

These observations require the presence of $(B_4O_6(OH)_2)^{-2}$ or $(B_6O_9(OH)_3)^{-3}$ groups. Since

the compound can apparently form by dehydration of borax without the appearance of a liquid phase the $(B_4O_6(OH)_2)^{-2}$ group is probably present.

Kernite.—$Na_2B_4O_7 \cdot 4H_2O$, monoclinic holohedral.

Space group $C_{2h}^4 - P2/c$ (9)

Unit of structure contains $4[Na_2B_4O_7 \cdot 4H_2O]$

$a = 15.65$	$c = 7.01A$
$b = 9.07$	$\beta = 108°52'$

Perfect cleavages parallel to (100) and (001) and other less developed cleavages parallel to the b axis (*8a*). Very slowly attacked by water. Loses approximately $1H_2O$ above 200°C. (*8a*).

These observations require the presence of chain polymers parallel to the b axis. The polymers are probably metaborates having the composition $(B_4O_6(OH)_2)_N{}^{-2N}$. The b periodicity (9.07A) is 5 percent greater than the c periodicity of the orthorhombic $Ca(BO_2)_2$, 8.56A, which is the distance required in that compound for 4 elements of the metaborate chain. (W. H. Zachriasen, G. E. Ziegler, Zeit. Krist. **83**: 354, 1932.)

(*E*). *Structural Information on HBO_2-I and B_2O_3*

Metaboric acid, HBO_2-I, was observed by Kracek, Morey, and Merwin (*10*) (KMM) to crystallize as rhombic dodecahedra with $n_D = 1.619$ and density = 2.486. Zachariasen (*10*) found that the cubic unit of structure has a = 8.88A and contains 24, HBO_2. B_2O_3 crystals have been formed only in the presence of $(HBO_2)_I$ and KMM noted marked parallelism between edges and possibly faces of the two growing together. "Crushing either induces a minute lamellar twinning, or possibly reveals a twinning caused by an *inversion*" (*10*).

X-ray powder diffraction patterns of crystalline B_2O_3 can be indexed on a hexagonal lattice having a = 4.33A and c = 8.392A (Mr. H. F. McMurdie, personal communication). If the density is 2.53 (measured value 2.460 (10)) this unit contains 3, B_2O_3. Refractive indices are ω (or β and γ) = 1.648 and ϵ(or α) = 1.615, the mean refractive index being 1.634 which is somewhat greater than that of HBO_2(I).

(*F*). *Valence Factors Involved in Polymerization of Silicates, Borates, and Phosphates*

A thorough discussion of electronic configurations in these groups is given by Linus Pauling in the *Nature of the chemical bond*, Ithaca, 1939. Specific references are: *Borates*, pp. 196–197, 219; *Sulphates, silicates, phosphates*, pp. 221–231, 375.

An adequate summary, stated by Pauling is: "Although the metasilicates, disilicates, and other silicates in which tetrahedron corners are shared are very stable, the corresponding compounds of phosphorus and sulfur are unstable. The explanation of this is the following: an oxygen ion shared by two silicon tetrahedra satisfies the electrostatic valence rule, whereas there is an infraction by 1/2 for the common corner of two phosphorus tetrahedra and by 1 for two sulfur tetrahedra. In consequence the pyrophosphates and metaphosphates are unstable—they do not occur at all as minerals and in solution they hydrolyze easily to orthophosphates—and the pyrosulfates are exceedingly unstable. It is for the same reason that silicon dioxide is stable but phosphorus pentoxide and sulfur trioxide combine with water with great avidity."

Oxygen ions shared by borate groups satisfy the electrostatic valence principle, and for this reason polyborates might be expected to have as great stability as polysilicates in aqueous systems. Contribution of double bond configurations to the borate structure, however, operate against equal sharing of all oxygen atoms as required for some of the elements of polyborates. Since half of the oxygen ions are unshared in metaborates these compounds would be expected to have the hydrolytic stability of polysilicates.

(*G*). *Information on Liquid Immiscibility in Binary Silicate and Borate Systems*

Liquid immiscibility in silicate systems has been studied by J. W. Greig (*16a*), and his publications should be consulted for additional information. Compositions at the lower limit of immiscibility and the temperature above which two liquids appear in a number of systems are indicated in the following table:

System	Temperature	Mole per cent SiO_2 at lower limit	Reference
MnO-SiO_2	1640°C	0.66	White, Howat, Hay, and Roy, Journ. Roy. Tech. Coll. Glasgow **3**: 239, 1933–36.
CaO-SiO_2	1698	0.71	Greig, *loc. cit.* (10)
MgO-SiO_2	1695	0.60	*Ibid.*
SrO-SiO_2	1693	0.80	*Ibid.*
FeO-SiO_2	1695	0.61	Bowen and Schairer, Amer. Journ. Sci. (5) **24**: 177, 1932.
ZnO-SiO_2	1695	0.66	Bunting, Bur. Stand. Journ. Res. **4**: 131, 1930.
CaO-B_2O_3	960	0.72	Carlson, Bur. Stand. Journ. Res. **9**: 825, 1932.
Mole per cent of SiO_2 required for			
RSi_2O_5		0.667	
$R_3Si_4O_{11}$		0.578	
Mole per cent of B_2O_3 required for			
$Ca_2B_{10}O_{17}$		0.724	
CaB_6O_{10}		0.750	

ETHNOLOGY.—*"Tapirage," a biological discovery of South American Indians.*[1]

ALFRED MÉTRAUX, Bureau of American Ethnology.

A striking feature of the Indian cultures of South America is the extensive use of feathers both for body ornaments and for decorations on weapons and other artifacts. Nowhere have feathers been worked more lavishly or with greater skill than there. Among the first treasures wrested from Brazil were the brilliant feather cloaks worn by Tupinamba chiefs. Today the National Museum of Copenhagen exhibits these masterpieces of the *ars plumaria*, as it has been called, among its most prized jewels.

The birds of the Tropics provided the most splendid materials for these fragile fabrics. The various representatives of the parrot family, with their bright wings and many with long tails, were in special demand, and large numbers of them were kept in every Indian village or encampment, both as pets and as reserve supply of feathers for new headdresses or arm bands. Despite the variety of feathers already at their disposal many Indian tribes found means of improving on nature.

Two chroniclers of the sixteenth century, Soares de Souza (1) and Magalhães de Gandavo (2), reported that the ancient Tupinamba Indians of the Brazilian coast knew how to change the color of the feathers on living birds. They took young common parrots, plucked their feathers, and smeared the bald spots with frog blood to which "certain other substances were added." The new feathers grew in yellow. The Portuguese immediately assumed that the Indians altered the plumage of common birds in order to cheat the White traders who might mistake them for specimens of some rare species.

That this technique was known to South American Indians long before Columbus may be surmised from its wide distribution throughout the continent. The Indian process was so familiar to the French colonists of the Guiana that they had a noun, *tapirage*, to designate the operation and a verb, *tapirer*, to express the action of changing the color of a bird's plumage. In Brazil, parrots that have been subjected to the process are called "contrafeitos."

Father Juan Rivero (3) has a good description of tapirage as it was practiced among the Achagua Indians of the Upper Meta River. "The Indians," he writes, "know how to make their parrots grow feathers of various colors, in order to increase their value, either for trade purposes or for their own use in their feasts. They obtain this result in the following way: They catch a live toad which they prick repeatedly with a thorn until the blood oozes. Then they place the animal in a pot and sprinkle its wounds with ground red pepper. The toad, enraged by the treatment, slowly exudes its active humors mingled with the poison and the blood. To this they add a certain red powder called 'chica' (*Bixa orellana*), and by blending these ingredients they make a pigment. They pluck the feathers of a parrot and smear it with this ointment which they insert with a stick into the holes left in the bird's skin. The parrot suffers and for several days remains sad as a sick chicken. Sometime later, the parrot's feathers grow again so splendid and so beautiful that everyone admires the beauty and elegance of the new plumage. Red spots stand out with remarkable variety on a yellow background among green feathers." The Guayupe and Sae were also experienced in the art of changing the color of the feathers by rubbing the birds with a "paste and poison."

Humboldt (4) makes only a bare reference to the process but gives us the name of the frog used in preparing the ointment. The latter is the *Rana tinctoria* or a closely related species. The naturalist Wallace has an interesting statement on this subject. "The Indians," he says, "pluck the birds which they wish to paint, and in the fresh wound inoculate the milky secretion from the skin of a small frog or toad. When the feathers grow again they are of brilliant yellow or orange color, without any mixture of blue or green, as in the natural state of the bird; and on the new plumage being again plucked out, it is said always to come of the same color, without any fresh operation. The feathers are renewed but slowly, and it requires a great number of them to make a coronet."

[1] Received April 20, 1944.

Tapirage is still practiced by the Indians of the Rio Negro and Uaupes areas. Koch-Grünberg (6) noticed that the Indians of the Aiary River region "pull from the tame red macaws the green feathers at the base of the wings and smear the wounds with the fat of the pirarara fish or of a certain toad. The new feathers become beautifully orange-yellow and retain this color, even if several times changed, as they are pulled out from time to time, for purpose of dance decorations."

The French naturalist La Condamine (7) mentions the process of tapirage and states that it was practiced by the Indians of the Oyapock River. This scientist expresses some doubts as to the virtues of the frog blood and believes that the change in the color of the feathers is the result of the use of some acrid substance or of some natural accident which may occur every time a living bird is plucked without the addition of any particular substance. In French Guiana tapirage was a specialty of the Carib tribes, of the Galibi, in particular, through whom the colonists learn about it.

South of the Amazon, tapirage occurs sporadically. It is reported for the eighteenth-century Mojo. "They pluck the tail and wing feathers of the blue parrots and in the wounds put the exudations of a toad and they stop them with wax to keep the liquid inside. Thus they cause the new feathers to grow reddish, a color that they never lose" (8). In the collections of the Göteborg Museum in Sweden there is a headdress of the Huanyam, an Indian tribe of the same region, which contains "tapiré" feathers.

The Munducuru (9) of the Tapajoz River smeared the plucked parrots with frog blood, the Bororo (10) of the Matto Grosso with the "sap of a certain tree." The process was so common among the Paressi Indians that it is mentioned in the eighteenth century by Pires de Campos (11) in his short account of this tribe.

The southernmost limit of tapirage is the Gran Chaco, where it has been described in great detail by Father José Sánchez Labrador (12). "The color which most appeals to the Mbayá men and women is yellow. But there are not sufficient birds in the country with feathers to satisfy their needs. Despite their simple minds, they have discovered the art of turning yellow the natural color of the plumes. They pluck them at certain times to get the colors which suit their taste. They pluck on a living parrot all the green feathers which they want to grow yellow, removing the large feathers, the down and the small barbs found under the feathers. On the bare surface they apply a pigment extracted from the roots of the logoguigo plant or of the *nibadenigo* tree (rucu, *Bixa orellana*). Both produce a saffron color. They rub these pigments with their fingers against the skin as if they wanted the blood to ooze. Only then do they put an end to the bird's martyrdom. When the new feathers grow, they look to see whether they are yellow or green. Generally they are of the former color, but if they see green ones among the yellow ones, they remove them and repeat the operation on the same spot. We never observed that they applied this procedure to any birds but parrots or that they used other pigments than the ones mentioned. Once the feathers have been plucked, the new ones are always yellow and never green."

Tapirage was also known to the Mocoví, who were closely related to the Mbayá (13). Very likely both tribes learned the process from the Arawakan Guana, who had migrated from the Amazonian Basin.

Today tapirage is still widely practiced by the mestizos of the States of São Paulo and Pará. They subject to the operation not only parrots but also birds of other species.

The German anthropologist Karl von den Steinen (14) supposes that tapirage was accidentally discovered by some Indian who rubbed a parrot with a medicinal substance after having plucked its feathers. The ornithologist Marshall (15) expresses some doubts as to the effects of the ointment on the change of colors, and he supposes that the transformation is the result of a special diet to which the plucked bird is subjected. He mentions the fact that goldfinches that have been fed oily seeds, such as colza or hemp, turn dark, and that canaries fed on Cayenne pepper become orange.

The Indians were aware of the effects of certain foods on birds' plumage and also seem to have used this method. Im Thurn (16) writes that the Macushi pulled out the feathers of birds, and smeared the wounds with rucu but that they also made the bird

drink "water in which more foroah (rucu) has been steeped, after which it is left for some months at the end of which time new yellow feathers have grown in the place of the abstracted ones." For the same purpose the Puinave give their parrots grease of the cajaro fish, a fish common in the Guaviare River (17). The plumage of a parrot put on such a diet first gets yellow spots and finally turns entirely yellow.

Father Constant Tastevin, a French missionary in the Upper Amazon region, sent me the following communication: "The Caboclos—the civilized Indians of the Solimoes—the Cocama, Cambeua, and others, feed their parrots the grease of the pirarara, a big fish called after the ara because of the red and yellow scales of its tail. Its grease has a lively yellow color and birds which eat it get a spotted red and yellow plumage which is considered very beautiful. The Caboclos change the color of their pet birds only to improve their appearance, not to increase their commercial value. People do not eat pirarara fish for several reasons—first, because it feeds on corpses, and, secondly, because it causes an unbearable itching to those who are afflicted with the skin disease called titinga or purupuru. This unpleasant disease is also ascribed to the consumption of this fish."

Koch-Grünberg found the same interpretation for the origin of the skin disease purupuru among the Indians of the Aiary region, and it is probable that these natives have also observed the effects of a diet of pirarara grease on the birds.

Do these facts indicate that in the change of color the diet alone is important or is it possible that the diet and the smearing of the plucked spots are equally effective, independently of each other?

The distinguished ornithologist Dr. Alexander Wetmore, of the Smithsonian Institution, kindly informed me that our data on tapirage are essentially correct and that the methods used by the Indians to change the color of the plumes were all equally efficient. In the case of frogs, it was not the blood, but the acrid secretion of the glands that provoked the change in color. When rucu is rubbed in the wounds left by the plucked feathers, the tissues absorb certain pigments that modify the color of the feathers. The influence of certain foods on the birds' plumage is well known; not only do canaries turn orange after eating red pepper, but in the zoos flamingos and scarlet ibises are fed crushed shrimps so as to keep their pink or red color, which they might otherwise lose. The color change occurs whenever the tissues absorb the pigment, irrespective of the method of application (19).

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LINGUISTICS.—*The origin of our State names.*[1] JOHN P. HARRINGTON, Bureau of American Ethnology.

The correspondence of the Bureau of American Ethnology has indicated for many years past that there is a widespread popular interest in the names of the States and Territories that compose the United States of America and that there has been constant demand for the probing into the origin and provenience of these names. During a period of years I have been collecting or assemblying truly vast materials on the subject of State and Territory names, and I early discovered that such collecting had never been done before by a person with a linguistic background and with government facilities. The names were found to dip deeply into both ethnology and history and many of them to be American Indian in origin.

Since the publication of all this material would be too bulky and expensive at the present time, the publishing of a preliminary, curtailed version is alone practical. The unraveling of a few of the names has been on the verge of the impossible, but every case nevertheless was attended with some success. Only in the instance of the name Oregon are further investigations still planned and in progress; the word is patently the same as the word hurricane, field work among French speakers in Canada having convinced me of this.

The two names Carolina and Dakota appear as State names only as oppositionally modified into pairs by the preplacing of North and South. New Hampshire, New Jersey, New Mexico, and New York have the preplacement of New, the first two by dint of contrast with British place names, the last two because of basin on Dutch and Spanish predecessor names. West Virginia alone has the setting of West. Rhode Island has the setting after it of Island, Virgin Islands of Islands. The two names Arkansas and Kansas are of one and the same origin, though derived through different channels. The District of Columbia is not termed a State. Only Alaska and Hawaii are still Territories. The Canal Zone, Puerto Rico, and the Virgin Islands are designated as Possessions.

ALABAMA. In origin the Muskhogean tribe name Alibamu. For a tribe name becoming used as a State name compare Arkansas, Dakota, Kansas, etc.

ALASKA. In origin the Aleutian name of the Alaska Peninsula.

ARIZONA. Papago Indian language for springlet.

ARKANSAS. In origin the name of a tribe or division, another form of the name Kansas.

CALIFORNIA. The early Spanish novel *Amadis de Gaula* consisted of four "books" written originally in Portuguese, probably by an author named Lobeira. These were translated into Spanish by Montalvo, who later independently wrote a fifth book entitled *Las Sergas de Esplandian*, first printed about 1511. The whole novel enjoyed unusually wide reading. In the fifth book is the first occurrence of the word California, as the name of an imaginary island, the queen for which was Calafia, and which island was infested with griffins. The entire setting of the section is the region of Constantinople, which was a city nearly as famous as Rome during the Middle Ages and with which city the caliphate was connected in every mind. Montalvo was undoubtedly thinking of the caliphate when he wrote California, and like a handwriting flourish at the end of the word his mention of the griffins led him to imitate Greek órnis, bird, or Latin ornaare, to adorn, wedged in as a third syllable, since to call the island Calafia would have made the name of the island and its queen identical. Montalvo claimed that he got the entire story from a Greek. Or Montalvo may actually have seen the famous old French Song of Roland, dating from about the year 1000, which has as its line 2924 "Californe" used of the caliphate —even with the -r- of Montalvo's "California." Modern Spanish orthography happens to have also Esplandian, without any accent on the vowel of the last syllable, thus coinciding in this word with the orthography of 400 years ago.

[1] Received February 15, 1944.

Canal Zone. Latin canaalis, canal, may be a remnant of an old submerged bunch of words having the stem of Sanskrit khan-, to dig; or it may be connected with Latin canna, reed—Spanish caña, cañón surely come from Latin canna. The second word of the name is in origin Greek zóonee, a woman's girdle.

Colorado. The river that empties into the Gulf of California very early became known in a variety of languages as the red river because of the chocolate color of its water. It has not generally been known that even in Latin colooraatus occurs meaning red, whence Spanish colorado, the ordinary and only vernacular word for red. Colorado was first applied as a description to the Little Colorado River, happening to agree with a description of the Colorado and of the Little Colorado which had since immemorial times been in vogue in several adjacent and near-lying American Indian languages.

Connecticut. In origin native Algonquian for long river, referring, of course, to the Connecticut River.

Delaware. Named for Thomas West, Lord De La Warr (1577–1618), a British soldier and colonial governor of Virginia, De La Warr being an English barony dating from the 13th century. As a landname, La Warre appears as the name of an estate in Gloucestershire, England. Gloucestershire is the country of the upper part of the mouth of the Severn River. The original Baron De La Warr, however, was from Sussex.

District of Columbia. The first word is from Latin districtus, masc., second declension, past-perfect participle of Latin distringere. The last word is from the artificial Latinized form, Columbus, of Colombo, surname of the Genoese who discovered America for the Spanish Kingdom. There is no proof whatever that Italian Colombo is connected with Latin columba, pigeon, Latin columbus, male pigeon. Latin forms country names in -ia, just as Greek does in -ía. One can actually find in old Spanish books the transitional spelling Colomb, which shows how Colombo was changed into modern Spanish Colón. The form Colombia is neither frying pan nor fire, but consists of taking Italian Colombo and changing its -o into -ia, while the straight artificial Latin form would be Columbia.

Florida. Ponce de León on Easter Sunday, 1512, caught sight of Florida, and named it from the day, just as children were accustomed to being named. Easter is called in the Spanish calendar of the saints la pascua florida, the springtime (literally flowery) passover. English misaccents the word, throwing the second syllable accent to the first syllable.

Georgia. Named from King George I of England. The name is, of course, in honor of St. George, whose name is in origin the Greek word for farmer, literally earth-worker. Today, for instance, Russian uses a word for farmer meaning earth-worker.

Hawaii. Long have I labored in vain trying to get the analysis or original etymology of the name Hawaii, pronounced in the Hawaiian Polynesian language hawáy'i. Professor Judd, of the University of Hawaii, writes me that all we can say is that this is the ancient Hawaiian name of the island on which Honolulu is situated.

Idaho. It was William Otogary who first informed me of the true origin of this name. Idaho was the name of the Salmon River Indians and one of the words best known to the early Whites. Adepts in the Shoshoni language state that this name means riverite, if there is such a word in English, or river-dweller, referring to the Salmon River.

Illinois. This is a French formation from the native Algonquian word for man, warrior, with addition of the French -ois as in Iroq-ois.

Indiana. Indiana was an early Indian refuge, much as Indian Territory was later an Indian refuge. Indiana is the Latin country name formation from Latin Indiaanus, better Indicus, a Hindoo. It was Columbus's own party that started applying the name India to the West Indies, thinking that the East Indies had been discovered. The name India is a Latin country formation in -ia derived from Latin Indus, the name of the great river of western India. This river is called in Sanskrit Síndhus, which is also applied to the region about the River Indus, and also the stream in general and even to the ocean. The word is imagined to be connected with the theme sidh-, and the river name therefore to mean something like goaler. In Greek, transmitted through Persian, and therefore with conversion of the s- into h- or nothing, the river name is Indós. Spanish indio, an Indian, is a corruption of indigo, and this for Latin Indicus. Greek has three forms for a Hindoo or Indian: 1, Indikós; 2, Indós; 3,

Indôoos; also a feminine Indís, a Hindoo woman. The Greek country name is India, but a corresponding form does not occur in Sanskrit.

IOWA. In origin a Siouan tribe name, apparently meaning putter to sleep.

KANSAS. The final -s is to be accounted for as French spelling of Kansa, Siouan tribe name. Arkansas is another version of this name.

KENTUCKY. Wyandotte Iroquoian for at the prairie.

LOUISIANA. Derivative of Louis, the earliest recorded spelling of which is Chlodowech. The Gothic of this name would have been *Hludaweiks, versal to *hludaweik, neuter, famous fight. There is evidence that the u of this name is short, hluda- and not hluuda-.

MAINE. The names Arcadie and Maine were both started by the very early French and applied to portions of what is now the State of Maine. Maine was a prominent province of older France, guessed to be the same as the second member of the Gallic tribe name from the time of Caesar which occupied the vicinity: Ceno-manni. Maine coast fishermen and others speak of the mainland as the main, but to connect this is a later popular etymology.

MARYLAND. Named for Queen Henrietta Maria, wife of King Charles I of England, who was daughter of King Henry IV of France. Mary is the Greek corruption of Hebrew Miryaam, and land is an old Germanic word for which Welsh and Polish cognates have been pointed out.

MASSACHUSETTS. Native Algonquian for flint hill.

MICHIGAN. Native Algonquian for large clearing.

MINNESOTA. From the name of a river. One can not do better than quote from Stephen R. Riggs's *Dakota-English Dictionary* (Contr. North Amer. Ethnol. 7: 316. 1890): "Mi′-ni-so-ta, *n. the Minnesota* or *Saint Peters River.* It means whitish water and is the name also of the lake called by the white people *Clear Lake.*" The Dakota Sioux name of what is now called officially the Minnesota River first appears in Jonathan Carver's *Travels through the interior parts of North America* (London, 1778) in the form "Menesoter," and the accompanying map has "Minesoter." It was Gen. H. H. Sibley who, in 1848, first launched the spelling Minnesota, which in 1849 became officialized in the designation of Minnesota Territory, while at the same time the Sioux name for Rivière de Saint Pierre, St. Peters River, was restored to Minnesota River.

MISSISSIPPI. Native Algonquian for big river, a mere description.

MISSOURI. Neighboring Algonquian for big canoe haver, a name applied to a Siouan tribe.

MONTANA. The common Latin adjective for mountainous is montaanus, from Latin mons, masc., mountain. Judging from other State names, one would naturally take Montana to be feminine singular, but it can also be taken as neuter plural, for instance like English errata.

NEBRASKA. According to what Francis La Flesche told me, this name occurs in almost the same form in Omaha Siouan and in closely related languages and means flat water. According to La Flesche, this was the Omaha term concomitant to the French Rivière Platte; both were descriptive in origin.

NEVADA. This State is named from the famous Sierra Nevada, Spanish for snowy range, which used to be in view of the Spanish ships very early sailing along the upper California coast. Spanish nevado literally means besnowed, but is used as the adjective for snowy. It is connected with Spanish nieve, fem., snow.

NEW HAMPSHIRE. In the second member of this name we have a short-cut with whole middle syllable left out for Anglo-Saxon Haamtuunsciir, fem., literally the county of Haamtuun, which literally translated means village-ville. We fortunately have absolute proof in Old English that the syllable -tuun- simply got left out.

NEW JERSEY. Jersey, with corrupt j- for ch-, is what the popular pronunciation of centuries has turned Caesaarea into. The Island of Jersey was a federal post, and termed in Latin (Insula) Caesareea. A more widely known Caesareea (Green loanword form Kaisáreia), literally federal-one, was a city in Palestine. The name is in origin the feminine of one of the adjectives derived from the name Caesar, which is related to Latin caesaries, fifth declension, hairiness.

NEW MEXICO. The second member is for Meshí'ko, Aztec place name. The vague northernmost province of Mexico was early termed Nuevo México in Spanish, and when the region was annexed to the United States, part of it

became the Territory, later the State, of New Mexico.

New York. After Professor Geary, excellent knower and speaker of Irish, has researched for years on the derivation of the word York, he still favors its meaning yew grove. I also have followed him, weighing all sources of information. York is actually recorded in Latinized form before the Anglo-Saxon invasion as Eboraacum. The form in ancient British, alias ancient Welsh, formerly spoken throughout England, must have been Eboraakon.

North Carolina. Carolina is the feminine, referring to country, in this instance to a colony, first bestowed in honor of Charles IX of France, subsequently of Charles I and Charles II of England. The artificial Latinized form of the name Charles is Carolus; for the explanation of the insertion of a middle vowel in which one need only point to Dutch Karel, Charles, which also has an easing vowel. Karl is an old Germanic name, the Gothic form of the name would have been *Karls. A form identical with the name also appears as one of the several words meaning man in Old Icelandic. That karl means man also in the sense of a male as opposed to the sense of female, is brought out in Old Icelandic, in which we have karla-foolk, males. In modern Icelandic slang karl means old-man. The personal name Karl is presumed to have had the same origin as the noun of general meaning.

North Dakota. The second member is a Siouan tribe name occurring in dialects with l- instead of d-, and said to mean originally friend; with this meaning compare the original meaning of Texas.

Ohio. Native Iroquoian meaning pretty, applied to the Alleghany Reservation, the Allegheny River, and to what is viewed as the down country extension of the Allegheny River: the Ohio River.

Oklahoma. A name started by the Rev. Wright, translating red person into Choctaw. The red man did not call himself red man in purely aboriginal times anywhere that I know.

Oregon. The name Oregon can be followed back to Rogers, who in 1765 wrote Ourigan. There is evidence, both as regards the life of Rogers and of his friend Carver and as regards the spelling used by Rogers, that the name is French Canadian in provenience, and field work in Canada and on the Pacific coast has convinced me of this. The word means in French Canadian squall or storm and is the same in ultimate origin as the English word hurricane.

Pennsylvania. William Penn in his own handwriting makes several references to the naming of Pennsylvania. Although not a Welshman, and born in the English-speaking border of Wales, Penn wanted the colony called New Wales, but King Charles II of England, who had the granting of the charter and the naming of the colony in his power, devised, or had suggested to him, the name Sylvania, which is English woodland translated into Latin, and the King then prefixed the name Penn to this in honor of the King's old acquaintance, William Penn's father, Admiral William Penn. Sylva, or silva, is the Latin for forest, and Greek hýlee, wood, earlier súlee, must be in some way connected with this, but records are inadequate for proving just how.

Puerto Rico. This is Spanish for rich harbor. Spanish puerto is from Latin portus, masc., fourth declension, harbor, this being the same word as Norwegian fjord and English ford. Rico is Spanish for an earlier ricco; Italian still has ricco. This adjective is taken over from Germanic, where we find Gothic reiks being the adjective of Gothic reiks, chief, and evidently meaning chieftainly, regal, powerful, rich. Spanish still uses rico meaning fortunate, for example in the sentence: You are very fortunate in still have a father.

Rhode Island. Although the very early Verranzano Relation compares Rhode Island in size with the Isle of Rhodes in the Mediterranean, the actual use of the name Rhode Island starts with the Dutch explorer Block, who calls Rhode Island in Dutch Roodt Eylandt, meaning red island, called from its red appearance; the writer remembers strikingly the red appearance of the neighboring Martha's Vineyard island when viewed from a boat.

South Carolina. The second member has been treated above.

South Dakota. The second member has been treated above.

Tennessee. A Cherokee village name, extended to become a river name and a region name, and finally a State name.

Texas. Caddo téysha, in earlier pronuncia-

tion táysha (just as Icelandic steinr, stone, is in the earlier Gothic stains), is used as a salutation meaning friend, and was widely known and used as a Caddo word and as a designation for Caddo and friendly Indians; compare the meaning of Dakota, which is said to have meant friend and was used as a regular tribe name.

Utah. Named from Spanish Yuta, Ute Indian, and the Spanish from Athopascan Indian meaning higher.

Vermont. Intended to be French for the Green Mountains, the correct standard French for which would be: les Montagnes Vertes.

Virgin Islands. In origin a religious name. Latin virgoo, a virgin, has been ingeniously connected by Brugmann with Greek parthenós virgin, but perhaps an easier etymology is to connect it with Latin virga, sprout.

Virginia. A colony name in artificial Latin in honor of Queen Elizabeth of England, who was fond of being known as the Virgin Queen.

Washington. Study of early spellings makes it absolutely certain that the name is Wassington, that the sh is a corruption, and that the Anglo-Saxon would have been Wassinga Tuun, the villa or stockade of the Wassings. There are two, and were formerly probably three, places in England by this name. Wassing is patently a patronymic derived from Wassa, an old weak-declension personal name not extant in Anglo-Saxon writings. The genitive of this would have been, of course, Wassan, but in Anglo-Saxon weak declension nouns were already taking -ing with loss of the -n-. Such an English adjective as Platonic, Plutonic, taken from Greek, retains the -n-, but Anglo-Saxon already formed Wass-ing from Wassa, with loss of the weak -n-. The meaning of the personal name Wassa is not known.

West Virginia. The second member has been treated above.

Wisconsin. In origin the native Algonquian name meaning grassy.

Wyoming. Native Delaware Algonquian for large prairie-place, corroborated by the Iroquoian equivalent being extant. Not an ancient name, but a descriptive one, given by Indians to the site of the present Wilkes-Barre, Pa.

BOTANY.—*A preliminary account of the plant diseases of El Salvador.*[1]

John A. Stevenson, Bureau of Plant Industry, Soils, and Agricultural Engineering, and Frederick L. Wellman,[2] Office of Foreign Agricultural Relations.

In the development of a national agricultural research program for the Republic of El Salvador it was deemed needful to make a study of the diseases affecting the economic plants of the country. Mycologists and plant-disease students have visited the Republic, but no one has hitherto made detailed collections of disease material. A knowledge of the naturally occurring plant diseases of a country is considered one of the essentials of an agricultural research program, and it has been one of the junior author's problems to obtain this information in El Salvador. The collections here reported were all made in 1943 during the months of May, June, July, and the first half of August. The six months' wet season had just begun when this work was started.

El Salvador has an area of 13,176 square miles, somewhat less for example than that of Switzerland. It has a number of volcanoes, with one or more that are still quite active, and elevations where crops are grown vary from sea level on the coastal plain bordering the Pacific Ocean to around 9,000 feet. Its climate is affected by the cordillera that marks its boundaries with Guatemala and Honduras, and on its higher tablelands and mountain slopes where cultivation of crops is most intensive, it is almost temperate in character. In the lowlands along the Pacific and in the lower river valleys, such as that of the Río Lempa, the temperatures are typical of the deep tropics. It is a thickly populated country with a backbone of stable agriculture; large holdings maintained by wealthy landowners, a few moderate-sized farms handled by those of lesser means, and, most numerous, small plots that are worked on a subsistence basis

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[2] The work of the junior author is in cooperation with the Centro Nacional de Agronomía of El Salvador.

by the shifting type of cultivation indigenous to the country. Certain crops have been grown in El Salvador since prehistoric times (e.g., maize, beans, squash), and others have been introduced within more recent times (e.g., sugarcane, coffee), while such plants as abacá and fiber roselle have been grown in the country but a few years.

Published accounts of the plant diseases of El Salvador have been comparatively few. Dr. David J. Guzmán (5) published in 1919 a work entitled *Fitopatologia, estudio de las enfermedades que afectan a las plantas agricolas de El Salvador.* It contains a general discussion of plant diseases and insect pests and their control, but very few concrete references to plant diseases occurring in El Salvador. Furthermore, a number of the diseases he recorded for the country are not present, for example, sugarcane smut. His reports have not been incorporated here.

Standley and Calderón (6) included in their *Lista preliminar de las plantas de El Salvador* fungi from the excellent collections of Standley, a number of which were economic forms and have been recorded here under the several hosts involved. Two of the rust fungi collected by Standley were named by Dr. J. C. Arthur (2) as new to science.

In more recent years studies of coffee diseases have been made at the Coffee Experiment Station at Santa Tecla and records of these published in reports by S. Calderón, J. A. Alvarado, and F. Choussy (1, 3, 4).

In the following account the material is presented on a host basis, and in alphabetical order of the technical names of the plants involved. Disease-producing fungi are also listed alphabetically under the hosts. Localities are given and the collector's numbers where available. The collector in all cases is the junior author unless otherwise specified. The specimens have been divided and a set deposited in the mycological collections of the Bureau of Plant Industry and a representative set has been taken by the junior author for deposit in El Salvador.

AGAVE spp. Sisal, henequen.

Colletotrichum agaves Cav. This anthracnose fungus produces oval leaf spots up to 1 cm in diameter with raised margins. On *Agave americana* L., Lake Ilopango Road, no. 300; on *A. fourcroydes* Lem., San Miguel, no. 240.

Diplodia theobromae (Pat.) Nowell causes a black rot of the leaves of *A. fourcroydes* Lem. (henequen), which brings about serious losses of fiber often reaching 25 percent of the crop in a given area. The fungus, which has been listed under a variety of names (*D. natalensis* P. Evans, *D. cacaoicola* P. Henn., etc.), attacks a wide range of tropical and subtropical economic plants causing fruit rot, twig and branch die-back, and leaf spots and rot. Noted particularly at San Miguel, nos. 239, 241, 243, 244, 414; La Libertad, no. 400. An earlier specimen from El Salvador on *A. sisalana* Perr., collector and exact locality unknown, is also in the herbarium of the Bureau of Plant Industry.

ALLIUM spp.

Alternaria porri (Ell.) Saw. Black mold and purplish lesions on leaves of *Allium cepa* L. (onion). La Ceiba, no. 19 and *Allium porrum* L. (leek), Cuscutlan, no. 310.

ALTHAEA ROSEA Cav. Hollyhock.

Virus. An undetermined virus characterized by yellow chlorotic leaf lesions mixed with light and dark green islands. La Ceiba, no. 22.

ANDIRA JAMAICENSIS (W. Wright) Urb.

Gloeosporium sp. Anthracnose on leaves Plaza, San Miguel, no. 215.

Polystigma pusillum Syd. Forming angular brown leaf spots. Previously known from Guatemala and the Dominican Republic. Under the name *Physalospora andirae* F. L. Stevens, the fungus has been collected in Puerto Rico, Virgin Islands, and Panama. San Miguel, no. 215; San Salvador, no. 309.

BAUHINIA spp.

Uromyces guatemalensis Vest. Rust on leaves of *B. ungulata* L. Tonacatepeque, Dept. San Salvador, Standley, no. 19471; Santa Ana, Dept. Santa Ana, Standley, no. 20357.

Uromyces jamaicensis Vest. Rust on leaves of *B. pauletia* Pers. San Vicente, Dept. San Vicente, Standley, no. 21286.

BETA VULGARIS L. var. CICLA L. Swiss Chard.

Cercospora beticola Sacc. A leaf spot produc-

ing fungus which is common throughout the range of the host. La Ceiba, no. 77; Cuscutlan, no. 313.

BOEHMERIA NIVEA (L.) Gaud. Ramie.

Virus. An undetermined virus was noted causing a severe stunting and mild leaf mottling of infected plants. Santa Tecla, no. 283.

BRASSICA OLERACEA L.

Alternaria brassicae (Berk.) Sacc. Black leaf spots on leaves of cabbage, La Ceiba Exp. Stat., no. 78; Volcano San Salvador, no. 350; on leaves of cauliflower (*B. oleracea* var. *botrytis* L.), La Ceiba Exp. Stat., no. 27.

BROMELIA KARATAS L.

Perisporium bromeliae F. L. Stevens. Black sooty patches on leaves. San Miguel, no. 245.

CAPSICUM FRUTESCENS L. Pepper.

Cercospora capsici Heald & Wolf. Leaf spot of common occurrence. La Ceiba Exp. Stat., no. 74; Cuscutlan, no. 316.

Cercospora diffusa Ell. & Ev. Diffuse, brown fungus patches on lower leaf surfaces. Cuscutlan, nos. 315, 316.

Virus. An undetermined virus with symptoms resembling those of common tobacco mosaic. La Ceiba, no. 75.

CARICA PAPAYA L. Papaya.

Oidium caricae Noack. This typical powdery mildew, in common with most other tropical forms of the family Erysiphaceae, does not produce the perfect or ascus stage. Originally described from Brazil but occurs sparingly in other papaya growing countries. La Ceiba Garden, no. 82.

Pucciniopsis caricae (Speg.) Earle. This fungus, producing small, circular, black, rust-like spots on papaya leaves, occurs wherever the host is grown and is economically important in producing premature death of infected leaves. It is also known as *Asperisporium caricae* (Speg.) Maub., and a perfect stage (*Mycosphaerella*) has been described, but not verified. La Ceiba, no. 82; Los Chorros, no. 301. The latter specimen is overgrown in part by an apparently undescribed white mold.

Virus. A definite virus disease characterized by severe malformation of older leaves and a stunting and mottling of young growth was noted at the La Ceiba Experiment Station, nos. 63, 64. The disease would appear to be similar if not identical with that reported for Jamaica and Puerto Rico.

CASSIA sp. Senna.

Rhizoctonia sp. A damping off of seedlings at La Ceiba, no. 330.

CENTROSEMA PUBESCENS Benth.

Uromyces neurocarpi Diet. Rust on leaves, Ahuachapán, Dept. de Ahuachapán, Standley, no. 19845.

CITRULLUS VULGARIS Schrad. Watermelon.

Pseudoperonospora cubensis (Berk. & Curt.) Rostew. Downy mildew. A common and often serious disease of this and other cucurbits. Shore of Lake Ilopango, no. 386; Valle San Juan, no. 430.

CITRUS AURANTIFOLIA (Christm.) Swingle. Lime.

Cephaleuros virescens Kunze. The algal leaf spot is common but never serious. Zapotitan, no. 365; Tejutla, no. 441.

Elsinoë fawcetti Bitanc. & Jenkins. The citrus scab fungus attacks the leaves and fruit, disfiguring the latter or even causing much premature dropping. Cuscutlan, nos. 318, 319.

Mycosphaerella sp. (?). A leaf spot characterized by brown, circular to irregular spots with much darker definite borders, showing on both surfaces of the leaves. The fungus is immature. Cuscutlan, no. 320.

COCOS NUCIFERA L. Coconut.

Diplodia cococarpa Sacc. Common on husks. Port of La Libertad, no. 399.

Exosporium palmivorum Sacc. Leaf spots on dead leaves. La Ceiba no. 393.

Leptosphaeria sp. On dead and dying leaf tips associated with the following.

Pestalotia (*Pestalozzia*) *palmarum* Cke. Associated with large, irregular, gray to deep brown leaf spots. La Cabana, no. 227; La Ceiba no. 292.

CODIAEUM VARIEGATUM (L.) Blume. Ornamental croton.

Gloeosporium sorauerianum Allesch. Anthracnose on leaves, marked by large, irregular, brown, diseased areas and often with premature defoliation. La Ceiba, no. 130.

Coffea arabica L. Coffee.

Capnodium coffeae Pat. The sooty mold of coffee following the presence of aphids, mealybugs, or other insects is common in most coffee-growing areas. It is doubtless a mixture of several species, but for the most part conidial and pycnidial stages only are present. The name applied here is one of convenience only. Santa Tecla, nos. 101, 111; Santiago de Maria, S. Calderon, no. 2232.

Cercospora coffeicola Berk. & Cke. The brown eyespot is one of the common coffee leaf spots, but one which causes relatively little damage. Volcano San Salvador, nos. 11, 342; La Ceiba Exp. Station, no. 88; near Santa Ana no. 417. Also reported by Calderón (3) and Alvarado (1).

Colletotrichum coffeanum Noack. The anthracnose fungus produces large, irregular, brown blotches on leaves. Santa Tecla, no. 110. Probably merely another strain of *Glomerella cingulata* (Stonem.) Spauld. & Schrenk.

Heterodera marioni (Cornu) Goodey. The root-knot nematode was found producing heavy infections of roots of seedlings at Santa Tecla, no. 278. Determination verified by G. Steiner.

Micropeltis applanata Mont. Fly-speck fungus on leaves. Santa Tecla, S. Calderón, no. 2237.

Mycosphaerella coffeicola (Cke.). Leaf spot. Volcano Quetzaltepeque (San Salvador), no. 342; Santa Ana, S. Calderón, collector.

Omphalia flavida Maubl. & Rangel. The American leaf or eyespot disease, which is caused by this fungus, is widespread in the American tropics on coffee and various other economic woody plants and is doubtless widespread in El Salvador but is reported to date only from Santa Tecla from the collections of S. Calderón (3). In the past the fungus has been classified erroneously as *Stilbum flavidum* Cke. and *Stilbella flavida* (Cke.) Lindau.

Rhizoctonia sp. Coffee seedlings killed by a "damping off" fungus of the genus *Rhizoctonia*, and probably a strain of *R. solani* Kuehn, were noted at Santa Ana, no. 21, and at Santa Tecla, nos. 105, 106.

Nonparasitic leaf abnormalities. Several types of bronzing, chlorosis, and similar disturbances were noted on coffee leaves at Santa Tecla, due possibly to lack of shade, soil deficiencies, and other environmental or cultural difficulties.

Cucumis sativus L. Cucumber.

Erysiphe cichoracearum DC. Powdery mildew occurs commonly on this host, but in the conidial (*Oidium*) stage only. La Ceiba Exp. Stat., no. 29.

Pseudoperonospora cubensis (Berk. & Curt.) Rostew. Downy mildew is a common disease on this host and often destructive. La Ceiba Exp. Stat. nos. 28, 72.

Virus. An undetermined virus disease was noted which was not typical of that due to *Marmor cucumeris* var. *vulgare* Holmes, but was characterized by the harsh, corrugated appearance of the leaves with vein clearing. La Ceiba Exp. Stat., no. 30.

Cucurbita spp. Pumpkin, squash.

Cercospora cucurbitae Ell. & Ev. Leaf spot on C. *maxima* Duchesne. Zapotitan, no. 425; Valle de San Juan, no. 431.

Erysiphe cichoracearum DC. Powdery mildew in the *Oidium* stage is common on all types of *Cucurbita*. Shores of Lake Ilopango, no. 385; Volcano de San Salvador, no. 261; San Andres, no. 362. The fungus on the first specimen cited is overgrown by *Cicinnobolus cesatii* D By.

Virus. An undetermined virus disease of the *Marmor* type characterized by severe mottling of leaves and stunting of plants of *Cucurbita pepo* L. occurred near Sacocayo, no. 146; shores of Lake Ilopango, no. 389; near Aguafria, no. 427.

Cymbopogon nardus (L.) Rendle. Citronella grass.

Virus. A leaf mottling typical of *Marmor sacchari* Holmes, which occurred on sugarcane in adjoining fields, was noted at Santa Tecla, no. 275.

Cynodon dactylon (L.) Pers. Bermuda grass.

Helminthosporium giganteum Heald and Wolf. The fungus causes yellow or straw-colored spots with narrow brown borders on leaves. Previously reported from Texas. Cafetelera Station, Santa Tecla, no. 276.

Puccinia cynodontis Delacr. The rust on this host is a widespread fungus, often injurious. Zacatecoluca, no. 434.

Datura stramonium L.

Alternaria crassa (Sacc.) Rands. On leaves. Los Planos, no. 4.

Virus. An undetermined virus causing chlorosis and stunting of infected plants was seen at Los Planos, no. 5.

Daucus carota L. Carrot.

Alternaria carotae (Ell. & Langl.). Leaf blight occurred at La Ceiba, no. 33; Volcano San Salvador, no. 341.

Desmodium spp.

Alternaria sp. Associated with a leaf-spotting, on *Desmodium* sp. Santa Tecla, no. 281.

Cercospora desmodii Ell. & Kell. Leaf spot on *Desmodium* sp. La Cabana, no. 225.

Isariopsis caespitosa Petr. & Cif. Angular leaf spot on *Desmodium* sp. Near Herradura, no. 390; Lagarto, no. 428. Doubtfully distinct from *I. griseola* Sacc., occurring on *Phaseolus* and other legumes.

Parodiella perisporioides (Berk. & Curt.) Speg. On leaves of *Desmodium nicaraguense* Benth. & Oerst. Santa Tecla, no. 280.

Uromyces hedysari-paniculati (Schw.) Farl. Rust on leaves of *Desmodium barclayi* Benth., Ahuachapán, Dept. de Ahuachapán, Standley, no. 19846; *Desmodium nicaraguense* Benth. & Oerst., Santa Tecla, no. 280; *Desmodium scorpiurus* (Sw.) Desv., near San Salvador, Standley, nos. 19651, 22743.

Virus. An undetermined virus marked by mottling of leaves of *D. rensoni* Painter, Santa Tecla, no. 282.

Epidendrum difforme Jacq.

Uredo guacae Mayor. A rust disfiguring the leaves of *Epidendrum* spp. and related orchids in Central America and the West Indies. The record of its occurrence in El Salvador is based on a specimen found by Plant Quarantine inspectors on a plant offered for entry at San Francisco.

Euphorbia pulcherrima (Klotzsch) Graham. Poinsettia.

Oidium sp. This appears to be the first report of a powdery mildew on this host. As is so commonly the case with tropical material, the perfect stage of the fungus is not present. It is possible that *Sphaerotheca euphorbiae* (Cast.) Salmon is the species involved. The fungus produces circular to irregular yellow to brown spots up to 1 cm in diameter, disfiguring the leaves and greatly lowering their ornamental value. La Ceiba, no. 96.

Ficus carica L. Fig.

Physopella fici (Cast.) Arth. The common fig rust brings about premature leaf fall. Finca Santa Ana, San Miguel, no. 210 (Uredo stage only).

Fragaria chiloensis Duchesne. Strawberry.

Mycosphaerella fragariae (Tul.) Lindau. This fungus, producing a typical and at times damaging leaf spot, has followed the cultivated strawberry around the world. The conidial stage (*Ramularia tulasnei* Sacc.) was collected near the top of Volcano San Salvador, no. 351.

Furcraea sp.

Colletotrichum agaves Cav. Anthracnose on leaves. San Miguel, S. Calderón, collector, no. 2549; near San Jacinto, no. 2556.

Dothidella parryi (Farl.) Th. & Syd. On leaves, near San Salvador, S. Calderón, collector.

Trichocladium olivaceum Mass. On leaves. San Miguel, S. Calderón, collector, no. 2549.

Gliricidia sepium H. B. K. Madre de cacao.

Cyphella villosa Pers. ex Karst. Associated with a die-back condition of branches and twigs. Santa Tecla, no. 59a.

Fusarium decemcellulare Brick. Associated with cankers on stem and branches. Collected by S. Calderón, Santa Tecla.

Isariopsis sp. Causes definite, dark brown spots, 2–4 mm in diameter, fruiting on the lower surface. San Andres, no. 359.

Phomopsis sp. Associated with a die-back of twigs. Does not appear to differ from *Ph. gliricidiae* Syd., nor from *Ph. citri* Fawc., which latter form Wehmeyer considers the imperfect stage of *Diaporthe medusaea* Nitsch.

Rosellinia pepo Pat. Black root rot on rotting roots. Santa Tecla, collected by S. Calderón.

Hibiscus sp. Fiber roselle.

Oidium sp. A powdery mildew on leaves which showed only the imperfect stage and hence was not further determinable, occurred at La Molina, Santa Ana, no. 305.

Vermicularia dematium Fr. Associated with cankered areas at base of plants. Santa Tecla, no. 122. Many plants at the Station have shown abnormal leaf fall and other abnormalities, but parasitic fungi do not appear to be involved and the trouble is more evidently the result of unfavorable environment. Various secondary fungi occur on dead and dying leaves and stalks.

INGA spp.

Perisporium truncatum F. L. Stevens. Black mildew on living leaves of *Inga preusii* Harms, vicinity of San Salvador, P. C. Standley.

Ravenelia ingae (P. Henn.) Arth. A rust on leaves and twigs of *Inga preusii* Harms, often causing malformations. La Ceiba, no. 368, on *Inga* sp. La Ceiba, no. 338; near San Salvador, P. C. Standley, no. 22461. The latter specimen was originally named as *R. whetzelii* Arth., now considered synonymous with *R. ingae.*

Virus. A possible virus disease producing a mottling of leaves of *Inga* sp. was observed at the La Ceiba Exp. Stat., nos. 334, 335, 336.

LACTUCA SATIVA L. Lettuce.

Septoria lactucae Pk. Leaf spot causing defoliation. La Ceiba, nos. 15, 194.

LYCOPERSICUM ESCULENTUM Mill. Tomato.

Cladosporium fulvum Cke. This common and often destructive leaf mold occurred on both native and introduced types. La Ceiba Exp. Stat. no. 81; Herredura, no. 391; Izalco, no. 421.

Septoria lycopersici Speg. Leaf spot was very severe on certain varieties, particularly the small fruited native type, near Volcan de Izalco, no. 175.

MANGIFERA INDICA L. Mango.

Colletotrichum gloeosporioides Penz. Mango anthracnose is common wherever the tree is grown, causing a blackening of the fruit. Young leaves are distorted and large, irregular deep brown blotches are produced on more mature ones. La Ceiba Exp. Stat., on fruit and leaves, no. 32; near Panchamalco, no. 397.

Phyllosticta mortoni Fairman. This fungus causes a leaf spot characterized by numerous, small, angular gray spots with definite dark-brown margins. Previously reported from Florida, Puerto Rico, Cuba, Guatemala, and Mexico. Sonsonate, no. 187; Finca Santa Ana, San Miguel, no. 211.

MANIHOT ESCULENTA Crantz. Manihot, yuca, cassava.

Cercospora henningsii Allesch. This fungus causes brown circular to irregular spots and blotches on the leaves, 5 mm or more in diameter in contrast to the small (2–3 mm) definite spots with white centers due to *C. caribaea* Cif. Near Mercedes, Umaña, no. 411; near Izalco, nos. 422, 423.

Odium manihotis P. Henn. The powdery mildew of this host is in the *Oidium* stage only, producing irregular light brown blotches on the leaves with a white powdery layer showing beneath. Also known from Central Africa, Brazil, and Peru. La Ceiba, no. 291.

Phyllosticta sp. Associated with small (1–2 mm) leaf spots, silvery white above, reddish brown beneath. Along shores of Lake Ilopango, no. 381.

Virus. Typical mottling, stunting and malformation of the *Marmor* type, associated with aphids. La Ceiba Exp. Stat., no. 290; near Mercedes, Umaña, nos. 412, 413.

MEDICAGO SATIVA L.[3] Alfalfa.

Bacterium alfalfae Riker, F. R. Jones & Davis (?). Bacterial leaf spot has been known heretofore only from the United States. Specimens from Santa Tecla, nos. 117, 118, 119, are doubtfully referred to this species.

Cercospora sp. (probably *C. zebrina* Pass.) Leaf spot. Santa Tecla, no. 117.

Rhizoctonia sp. Associated with bleached spots on stems. Santa Tecla, no. 120.

Uromyces striatus Schroet. The rust is common and widespread on this host in El Salvador but not serious. Santa Tecla, nos. 116, 118.

MELICOCCA BIJUGA L. Spanish lime.

Virus. An undetermined virus causing severe mottling of leaves. La Ceiba, no. 90.

MUSA PARADISIACA L. Banana.

Cercospora musae Zimm. The "sigatoka" disease of bananas, which has caused heavy losses in many banana-growing countries was collected at La Ceiba, no. 79, and at Tomatopeque, no. 438.

Cordana musae (Zimm.) Hoehn. Cordana leaf spot attacking the "Cavendish" variety, Los Planos, no. 2.

PACHYRHIZUS sp. Jicama.

Isariopsis griseola Sacc. This species, causing an angular leaf spot, is usually confined to *Phaseolus* and its reference to *Pachyrhizus*, a new host genus is somewhat doubtful. However it does not appear to differ morphologically from the form on *Phaseolus*. La Ceiba, nos. 99, 100, 455.

[3] All determinations of organisms on *Medicago* are by C. Lefebvre.

PANICUM spp. Panicum grasses.

Cercospora fusimaculans Atk. A leaf-spot disease characterized by linear brown spots on Guinea grass (*Panicum maximum* Jacq.). San Andres, no. 357; Zacatecoluca, no. 433. Previously known from Colombia, Panama Canal Zone, and Brazil as well as the southern United States.

Uromyces leptodermus Syd. Rust on leaves of *Panicum purpurascens* Raddi (*Panicum barbinode* Trin.) Pará grass. Near San Salvador, Standley, no. 19677.

PASPALUM spp.

Claviceps paspali F. L. Stevens & J. G. Hall. This common *Paspalum* ergot fungus, which is poisonous to livestock, was collected at Montserrate, no. 485, on *Paspalum* sp.

PASSIFLORA QUADRANGULARIS L. Granadilla.

Cercospora regalis Tharp. Leaf spots. La Ceiba, no. 34.

PERSEA spp. Avocado and relatives.

Cercospora purpurea Cke. (?). The common leaf-spot-producing fungus of the avocado (*Persea americana* Mill.) is tentatively assigned to this species, pending more detailed study. It produces numerous, small, angular, dull brown spots and has been previously known from the state of Florida. A possible perfect stage (*Mycosphaerella*) has been reported by H. E. Stevens from that State. La Ceiba, no. 462.

Cephaleuros virescens Kunze. The algal leaf spot was common and abundant on *Persea schiedeana* Nees, an avocado relative, intermingled with *Strigula complanata* Fee, a leaf inhabiting lichen. Santa Tecla, nos. 115, 116.

PETROSELINUM CRISPUM (Mill.) Nym. Parsley.

Cercospora apii Fres. Leaf spot. Slopes of Volcano de San Salvador, no. 340.

PHASEOLUS LUNATUS L. Lima bean.

Elsinoë phaseoli Jenkins. Lima bean scab was found on the leaves and pods of a specimen collected by S. Calderon, San Salvador, and deposited at the Gray Herbarium, Cambridge, Mass. (Phytopathology **23**: 602. 1933).

PHASEOLUS VULGARIS L. Bean.

Chaetoseptoria sp. See discussion of this fungus under *Vigna* (cowpea). La Ceiba, nos. 126a, 126b, 128.

Isariopsis griseola Sacc. Angular leaf spot is common on beans in all localities and does some damage. La Molina, nos. 306, 307; Cuscutlan, no. 312, slopes of Volcano San Salvador, no. 343; near Izalco, no. 419.

Myrmaecium roridum Tode. On matured pods near Paraiso, no. 449.

Periconia pycnospora Fres. On matured pods, near Paraiso, no. 449a. Determined by E. K. Cash.

Uromyces phaseoli typica Arth. The universally distributed bean rust contributes directly to crop reduction by destruction of leaves. La Ceiba, no. 128; near Sacocoyo, nos. 136, 137; La Molina, Santa Ana, nos. 306, 307; near Izalco, no. 420; near Paraiso, no. 448; vicinity of San Salvador, collector Standley, nos. 19600, 23303. (Reported by Standley and Calderón (6) as *U. appendiculatus* [Pers.] Fr.)

Vermicularia polytricha Cke. On matured pods. Near Paraiso no. 449.

PHOENIX sp. Palm.

Graphiola phoenicis (Moug.) Poit. The false smut of *Phoenix* and related palms is omnipresent and always disfiguring. La Ceiba, no. 16.

PITHECELLOBIUM DULCE (Roxb.) Benth.

Microstroma pithecolobii Lamkey. This fungus, causing a leaf mold disease, has been known previously only from Puerto Rico on *Samanea saman* (Jacq.) Merr. La Ceiba, no. 86.

Virus. Causing a yellow mottling of leaves. La Ceiba, no. 87.

PRUNUS PERSICA (L.) Batsch. Peach.

Tranzschelia pruni-spinosae (Pers.) Diet. The peach leaf rust occurs co-extensively with its host and is often a serious defoliator. Los Planos near San Salvador, no. 6; slopes of Volcano San Salvador, no. 344. The latter specimen is parasitized by *Darluca filum* (Biv.) Cast., which possibly helps to keep the rust in check.

PSIDIUM GUAJAVA L. Guava, Guayaba.

Meliola psidii Wint. Black mildew on leaves, common, but not serious. San Salvador, P. C. Standley, collector.

PUNICA GRANATUM L. Pomegranate.

Cercospora punicae Syd. Leaf spot, not serious. C. *lythracearum* Heald & Wolf is synonymous. La Ceiba, no. 492.

RAPHANUS SATIVUS L. Radish.

Albugo candida Pers. ex Kuntze. The white rust is common and widespread, but seldom destructive, wherever the host is grown. La Ceiba Exp. Stat., no. 73.

RICINUS COMMUNIS L. Castor bean.

Cercospora ricinella Sacc. & Berl. This common leaf spot producing fungus characterized by numerous, small circular to angular, white centered spots causes severe defoliation at times. San Andres, nos. 198, 199, 200; San Miguel, no. 216.

ROSA spp. Rose (cultivated varieties).

Actinonema rosae (Lib.) Fr. This common and widespread disfiguring leaf spot disease known as "black spot" was collected at the La Ceiba rose garden, no. 23 and at Cuscutlan, no. 314. The fungus also has a perfect stage (*Diplocarpon rosae* Wolf) not yet found in Salvador.

Cercospora puderi B. H. Davis. This fungus causes small spots (up to 4 mm in diameter) with gray centers. La Ceiba rose garden, nos 24, 25. This species has been previously known from the southern United States and Mexico, but is much less common than the ubiquitous *C. rosicola* Pass., which is characterized by larger spots and with sporulation on both surfaces.

Diplodia sp. Associated with dieback. La Ceiba Exp. Stat., nos. 66, 67.

Stilbella cinnabarina (Mont.) Wr. Fruiting on dead and dying stems of *Rosa odorata* Sweet. La Ceiba rose garden, no. 69.

RUBUS spp.

Elsinoë veneta (Burk.) Jenkins. Anthracnose on stems and leaves of a blackberry (*Rubus* sp.) near the top of Volcano San Salvador, no. 347. The imperfect stage only (*Sphaceloma*) of the fungus was present. Determination by Anna E. Jenkins.

Spirechina rubi (Diet. & Holw.) Holw. Rust on leaves of *Rubus adenotrichos* Schlecht. Volcan de San Salvador, collector P. C. Standley.

SACCHARUM OFFICINARUM L. Sugarcane.

Leptosphaeria sacchari V. B. de Haan. The "ring spot" disease due to this fungus is common on older leaves, as in all other cane growing countries. La Cabana, nos. 221, 231.

Virus. Mosaic (*Marmor sacchari* Holmes) is prevalent and severe throughout the country on susceptible varieties.

SALIX CHILENSIS Mol. Willow.

Melampsora abieti-capraearum Tub. (*Melampsora humboldtiana* Speg.) Rust on leaves. Ahuachapán, Dept. de Ahuachapán, Standley, 20255.

SECHIUM EDULE Sw. Chayote, huisquil.

Rhagadolobium cucurbitacearum (Rehm) Th. & Syd. Tar spot disease of the leaves, disfiguring, but seldom serious. La Ceiba, no. 70.

SOLANUM spp.

Cercospora diffusa Ell. & Ev. Black leaf spot on *S. nigrum* L. Shores of Lake Ilopango, no. 384.

Cercospora solani-torvi Frag. & Cif. Leaf spot on *Solanum* sp. (probably *S. torvum* Sw.), near Zaragoza, no. 402.

SORGHUM HALEPENSE (L.) Pers. (*Holcus halepensis* L.) Johnson grass.

Cercospora sorghi Ell. & Ev. Causing a leaf spot near Herradura, no. 395.

Gloeocercospora sorghi Bain & Edgerton. Leaf blotch, a disease heretofore known only from the southern United States. La Laguna, no. 322.

Helminthosporium turcicum Pass. La Laguna, no. 322.

Puccinia purpurea Cke. The rust was collected by S. Calderón, no. 41a.

SORGHUM VULGARE (L.) Pers. (*Holcus sorghum* L.) Sorghum.

Cercospora sorghi Ell. & Ev. Leaf spots, common at La Ceiba, no. 132.

Colletotrichum graminicolum (Ces.) G. W. Wils. Anthracnose. West of San Vicente, no. 208; near San Jose del Sacario, no. 443. World wide on most species of grasses.

Helminthosporium turcicum Pass. Leaf spot and blotch. La Ceiba, no. 132.

Puccinia purpurea Cke. Very common everywhere on this host, producing large irregular, deep red blotches on leaves. La Ceiba, Puerta, no. 375.

Virus. Near sugarcane fields, where sugarcane mosaic (*Marmor sacchari* Holmes) was present, and hence the same virus is probably involved here. Santa Tecla, no. 269.

SORGHUM VULGARE var. SUDANENSE (Piper) Hitchc. (*Holcus sudanensis* Piper). Sudan grass.

Cercospora sorghi Ell. & Ev. Leaf spot. La Ceiba, nos. 131, 133, and 135.

TECOMA STANS (L.) H. B. K.

Prospodium appendiculatum (Wint.) Arth. Rust common on the leaves of this ornamental

tree. Ahuachapán, Dept. de Ahuachapán, Standley 19905; near San Martín, Dept. de San Salvador, 22590.

TETRAGONIA EXPANSA Thunb. New Zealand spinach.

Cercosporina tetragoniae Speg. Leaf spot. Slopes of Volcano San Salvador, no. 348.

TRITICUM AESTIVUM L. Wheat.

Puccinia rubigo-vera tritici (Erikss. & P. Henn.) Carleton. Both stages (uredial and telial) of this common leaf rust of wheat were found. Slopes of Volcano San Salvador, nos. 247, 248, 249, and 353.

Septoria tritici Rob. A scanty collection of this common wheat parasite was made on the slopes of Volcano San Salvador, no. 353.

VIGNA SINENSIS (Torner) Savi. Cowpea.

Cercospora canescens Ell. & Martin. Leaf spot near Sacocoyo, nos. 140, 143.

Chaetoseptoria sp. This fungus was associated with large, circular leaf spots. Tehon described (Mycologia **29**: 444–445. 1937) the genus as new and established the species *C. vignae* on *Vigna sinensis*. The Salvador fungus has conidia up to 150μ long in contrast to 18–50μ reported by Tehon for those of *C. vignae*. The pycnidia are also much larger than those of the Illinois fungus. Near Sacocoyo, no. 140; Zapitotan, no. 424.

Erysiphe polygoni DC. This powdery mildew, in the *Oidium* stage only, as is usual in tropical collections, was collected at Los Planos, near San Salvador, no. 3.

VITIS VINIFERA L. Grape.

Alternaria vitis Cav. Associated with leaf spots. Los Planos, near San Salvador, no. 8.

Mycosphaerella sp., in circular light-brown leaf spots, with dark brown definite borders. La Laguna, no. 325.

Physopella vitis (Thuem.) Arth. The grape rust, also known as *Phakopsora vitis* (Thuem.) Syd., occurs commonly on vinifera grapes, causing some defoliation; the fungus also is present in the southern United States, the West Indies, Guatemala, and northern South America. Los Planos, near San Salvador, no. 7; Santa Ana, no. 308; San Salvador, no. 463.

YUCCA ELEPHANTIPES Regel. Izote.

Didymosphaeria sp. A species, distinct because of its larger spores from *D. yuccogena* (Cke.) Sacc. and *D. clementsii* Sacc. & D. Sacc., causing leaf spots was found on the lower slopes of Volcan de San Salvador, no. 267.

Gloeosporium sp. (*Gl. yuccigenum* Ell. & Ev.?) Anthracnose of leaves, forming large concentrically zoned diseased areas. Lower slopes, Volcan de San Salvador, nos. 266, 267.

Leptosphaeria obtusispora Speg. The fungus produces large, irregular, dull brown blotches on the leaves. It differs from the more common *L. filamentosa* Ell. & Ev. in its 5-septate spores as contrasted to the 3-septate spores of the latter species. La Ceiba, no. 332.

Sphaerodothis pringlei (Pk.) Th. & Syd. Tar spot fungus on leaves. On lower slopes, Volcan de San Salvador, no. 267; slopes of Volcan San Salvador, no. 354.

ZEA MAYS L. Corn, maize.

Angiopsora zeae Mains. This is one of the rarer rust fungi occurring on *Zea*, heretofore reported as found sparingly in Puerto Rico, the Dominican Republic, Guatemala, and Trinidad. For a discussion of this and certain of the other corn rusts see article by G. B. Cummins (Phytopath. **31**: 856–857. 1941). Zapotitan, nos. 360, 361 (both uredial and telial stages.)

Cercospora sorghi Ell. & Ev. A common leaf spot producing fungus. La Ceiba, nos. 378, 379; near Herradura, no. 394. Distinct from *C. zeae-maydis* Tehon and Daniels, which is described with conidia 5–9μ wide, in contrast to 3μ as described for the former.

Cladosporium herbarum Lk. Associated with large irregular, dead areas on leaves, near San Estabán, nos. 409, 429. Other fungi present were *Alternaria* sp., *Fusarium* sp., *Periconia* sp., and *Nigrospora oryzae* (Berk. & Br.) Petch all possibly secondary.

Curvularia geniculata (Tracy & Earle) Boed. Associated with elongated brown lesions on leaves. La Cabana, no. 237.

Diplodia zeae (Schw.) Lév. Ear rot. La Ceiba, no. 373.

Fusarium sp. Associated with ear rot and occurring also with other molds on leaves and husks. La Ceiba, no. 372.

Helminthosporium turcicum Pass. A very common and widespread fungus on maize in Salvador and one that apparently causes much damage by destroying leaves. Secondary fungi quite commonly are present also on diseased material. Near Sonsonate, nos. 151, 152; near

Izalco, no. 177; Zapotitan, nos. 188, 189; San Andrés, nos. 159, 164, 193, 194, 195; La Cabana, nos. 235, 238; La Ceiba, no. 377; near San José del Sacario, no. 444.

Nigrospora oryzae (Berk. & Br.) Petch. Associated with leaf spots, and cob rot, La Union, no. 429.

Physoderma zeae-maydis Shaw. This fungus causes the disease known as brown spot. It is an important and widespread disease of corn in tropical and subtropical countries, there being reports of its occurrence in China, India, Central Africa, Brazil, and Guatemala. Although described originally from India, it is doubtless of American origin and Tisdale (Journ. Agr. Res. **16**: 137–154. 1919) says of it, "It is possible that the disease was introduced into the United States from Mexico or Central America with *Euchlaena mexicanum.*" *Physoderma maydis* Miy. described from Japan does not appear to differ. The Salvador material is typical both in the disease symptoms and in the morphology of the fungus except that the sporangia are somewhat smaller (15–18 by 15–21μ) than those described by Tisdale. Near Sonsonate, no. 176; near Izalco, no. 177; La Ceiba, nos. 123, 125; San Andrés, nos. 160, 161, 164, 194; Zapotitan, no. 367.

Puccinia pallescens Arth. A second species of rust found sparingly in the uredial stage only at Los Planos, near San Salvador, no. 1.

Puccinia polysora Underw. The third species of corn rust prevalent in the country. Found in both uredial and telial stages, near Talchalaya, no. 446; and near Paraiso, no. 447.

Puccinia sorghi Schw. The most common and widespread of the four species of rust attacking *Zea.* Collected around the edge of the crater of Volcano de San Salvador, nos. 253–258. The rust on several of the specimens is overgrown by the ubiquitous rust parasite, *Darluca filum* (Biv.) Cast.

Ustilago maydis (DC.) Cda. (*U. zeae* [Beckm.] Unger.). The common corn smut occurs abundantly as in all corn growing countries. La Ceiba, no. 370; near Izalco, no. 436; near Paraiso, no. 451.

Virus. An undetermined virus disease causing a mottling of leaves was noted near Sonsonate, no. 174.

ZINNIA ELEGANS Jacq. (*Crassina elegans* [Jacq.] Kuntze). Zinnia.

Cercospora zinniae Ell. & Martin. This leaf spot fungus causes serious defoliation of the zinnia in El Salvador. *C. atricincta* Heald & Wolf, named from Texas, does not appear distinct. La Ceiba Exp. Stat., nos. 62, 76; Sonsonate, no. 180.

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ENTOMOLOGY.—*A new species of* Anopheles *from the Solomon Islands.*[1] JOHN N. BELKIN and RALPH J. SCHLOSSER, Sanitary Corps, U. S. Army. (Communicated by ALAN STONE.)

In the Lunga district of Guadalcanal Island, British Solomon Islands Protectorate, a survey of the anophelines was made. Four distinct forms of anophelines were encountered, a species of *Bironella* (*walchi?*), two forms of *A. punctulatus* Dönitz, and a species of *Anopheles,* which is described herewith. In reports from this area in the past few months this species has been called *A. p. punctulatus* Sw. & Sw. Investigations of the role of *A. p. punctulatus* in the transmission of disease on this island were actually carried out with this new species and not with *A. p. punctulatus* as reported. A summary of these investigations is given at the end of the paper. The senior author was very for-

[1] Received June 29, 1944.

tunate in enlisting the assistance of the junior author in the preparation of the illustrations.

Anopheles (Myzomyia) lungae, n. sp.

Adult female.—A medium-sized yellowish, speckled anopheline with the apical third of the labium yellow. Length of wing 4 mm.

Head (Fig. 2): Conspicuous white frontal tuft; vertical setae white, followed by one or two rows of white narrow hair-like scales; white scales on top of vertex forming a wide spot narrowed in the center; the rest of vertical scales and the occipital scales dark. Antenna with a few minute white scales on torus and dense white scaling on the first flagellar segment. Palpi ornamented as shown in Fig. 2; ornamentation very constant, the light scales yellowish on the last segment and white on the rest. Labium densely covered with yellow scales on apical third, yellow coloration broken by narrow dark ring just proximad of apex. Labella dull yellow.

Thorax (Fig. 3): White scales on anterior promontory rather short and scarce, central scales elongate, lateral broader. A few dark scales below. Rest of mesonotum devoid of scales, except for very narrow whitish scales in front of wing root; vestiture consisting of numerous golden hairs of varying length. Mesonotal integument light brown with gray pollinose longitudinal lines; dark brown eye spots in front of and behind scutal angle; prescutellar space dark brown. Mesonotal bristles light in color. Pleura darker with a broad blackish longitudinal line dorsally. Spiracular bristles absent, propleurals 6, lower sternopleurals 3, upper sternopleural 6–8, prealars 4–6, subalars 5–6, lower mesepimerals absent.

Wing (Fig. 1): As in figure; pale areas light yellow, dark spots often more conspicuous than shown in figure, scales rather broad. Median dark spot includes base of vein 2; a dark spot on costa between basal and median dark spots; subcosta and vein 1 without dark spots in this area; small black spots, shown in figure, between median and preapical black spots sometimes absent.

Legs (Fig. 4): Front femora swollen in basal half, speckled; middle and hind femora and all tibiae with rather evenly spaced pale spots externally. First segment of front tarsus with several light spots and light apex; second, third and fourth segments with basal and apical light bands; fifth segment dark basally, remainder light. First segment of middle tarsus similar to corresponding segment of front tarsus; second, third and fourth segments with basal light bands only; fifth segment all dark. First segment of hind tarsus with numerous light spots and light apex, second segment with light apical band and usually one to three light spots in the center; third segment with light apical band and occasionally a few light scales in center; fourth segment with light apical band; fifth segment all dark. Light scales on legs yellowish. Dark scales on middle tarsus much lighter than on other tarsi.

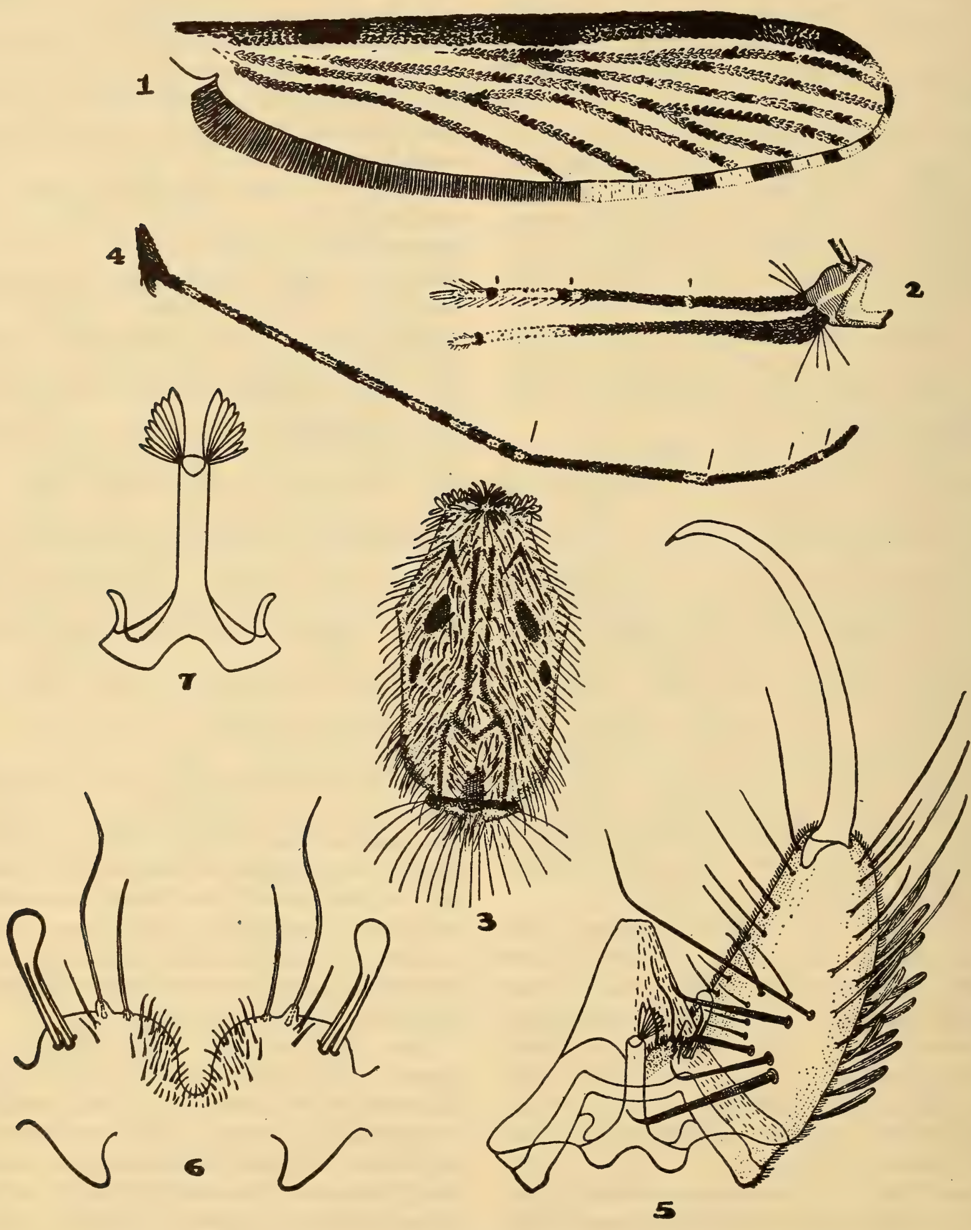
Abdomen: Devoid of scales on tergites and sternites; instead, a vestiture of narrow golden hairs similar to those found on mesonotum. Hairs more numerous on posterior segments. Cerci with rather narrow yellow scales.

Adult male.—In the main as the female. First flagellar segment with a tuft of long narrow white scales resembling frontal tuft. Palpal ornamentation essentially as in female; segment with 2 yellow scales dorsally in middle; third segment with narrow apical yellow ring and a few yellow scales dorsally in middle; fourth and fifth segments yellow with narrow basal dark rings. Labium all dark except for a few yellow scales at apex, labella dull yellow. Abdomen as in female except for numerous yellow scales on eighth tergite. Side pieces densely covered with yellow scales; black scales present laterally.

Male Genitalia (Figs. 5–7): Side pieces broad. Parabasal spines 5, spine 4 separated from 1–3. Claspettes (Fig. 6) with elongate club composed of four fused spines; apical hair almost twice length of club; inner accessory hair as long as club; two small hairs arising near base of apical hair. Phallosome (Fig. 7) elongate with parallel sides; leaflets 7–8, quite broad, the longest about one-fourth length of phallosome, serrations absent (?).

Larva.—Head (Fig. 8): Inner clypeals widely spaced, quite heavy, but short; outer clypeals extremely short; posterior clypeals similar to outer clypeals. Frontal hairs with branching as shown in figure. Occipitals and orbitals short, bifurcate. Antenna with fairly conspicuous spines on inner surface; antennal hair minute arising one third from base; terminal hair with about five branches arising from base, slightly longer than sabers; basal hair normal; subbasal short, three branched.

Thorax (Fig. 9): Prothoracic hair 1 with heavy basal tubercle, heavy shaft and radiation branching, approximately half as long as hair 2; hair 2 not quite so long as hair 4, with heavy basal tubercle, heavy shaft, and five to six branches on each side; hair 3 small, simple; hair 5 with very thick shaft, minute lateral branches except near apex where branches are long; hair 6 simple, longer than 5. Prothoracic pleural hairs 9 and 10 long and simple; hair 11 long with three to five branches; hair 12 simple or bifid, about one-third length of long hairs. Mesothoracic pleural hairs 9 and 10 long and simple; hair 11 short, with two or three



Morphology of Adult Anopheles lungae

Fig. 1.—Wing of female. Fig. 2.—Mouthparts of female. Fig. 3.—Mesonotum of female. Fig. 4.—Hind tarsus of female. Fig. 5.—Male genitalia. Fig. 6.—Claspettes. Fig. 7.—Phallosome.

branches, hair 12 minute. Hair 1 on mesothorax with thickened shaft. Hair 1 on metathorax forming a palmate hair with approximately 8 leaflets, leaflets not pigmented.

Abdomen (Fig. 9): Palmate hairs very large and heavily pigmented on segments III–VII, somewhat smaller on VII; poorly developed on I; fairly well developed (12 or more leaflets) but lightly pigmented on II. Leaflets (Fig. 11) numbering 16 to 26 on segment III and IV, well-pigmented; filaments short, indentations not numerous. Lateral hair on segment III with approximately six branches on each side, arising well away from base; lateral hairs on segments IV and V usually double; lateral hairs on VI with five to six branches. Anterior tergal plates rather small; posterior tergal plates very small, present on segment IV–VII. Median plate of scoop well developed. Pecten (Fig. 10) with 3–4 long and 6–8 short spines, the serrations at their bases very fine and inconspicuous; the pecten hair with 4–5 branches. Caudal hooks 6–8. Anal gills much longer than anal segment.

Types.—Holotype ♀, allotype ♂, paratypes 20 ♀, 20 ♂ collected resting on tree trunks, Tassafaronga Swamp, Guadalcanal Island, January 28, 1944 (Belkin); paratypes 5 ♀, 4 ♂ reared from larvae collected in Wright's Creek, Guadalcanal Island, November 11, 1943 (Belkin); paratypes 10 ♀, 15 ♂ collected on tree trunks, Burns Creek, Lunga, Guadalcanal Island, March 10, 1944 (Belkin). Holotype and allotype to be deposited in U. S. National Museum.

Identification.—This species can be separated easily from the forms of *A. p. punctulatus* in both the male and female by the very large median dark spot on the wing, the yellowish scales on the wings and palpi, the absence of white scales on most of the mesonotum and the presence in their place of yellow hairs. The larvae are easily distinguished by the very short outer clypeals, simple inner clypeals, the very characteristic prothoracic hairs 1 and 2, the palmate hairs, and the pecten. On pleural hairs this species does not quite agree with other members of the group *Myzomyia* to which it apparently belongs. The combination of characters exhibited by this species is not found in any previously described form. Seventy individual rearings of larvae established the identity of this form.

Distribution.—*Anopheles lungae* is generally distributed along the northwest coast of Guadalcanal Island. It may be present also on some of the other Solomon Islands.

Biology.—The larvae of this species are normally found in the jungle in seepage areas, along the margins of streams, pot holes in stream beds, rock holes, dense jungle swamps, and temporary pools. The species has a decided preference for shade in its breeding places. During the rainy season the larvae are flushed out into the coconut groves on the coastal strip where the species then breeds. The diurnal adult resting places were first discovered by Capt. F. B. Whittington. Adults are usually found resting in partial shade on tree trunks in the jungle. Males, unfed, blooded, and gravid females are all found together. Other resting places have been found under logs, inside crates, boxes, oil drums, foxholes, and nail kegs.

As this species becomes very abundant early in the rainy season on the northwest coast of Guadalcanal, preliminary investigations were conducted on its feeding habits and its relation to disease transmission in this area. On several occasions areas with a high adult density of this species were visited at night and biting records made. Males and females were observed leaving their daytime resting places between 6:30 and 7:00 p.m.; after 7:30 none could be found resting. Although the biting records were made among the trees where the anophilines were resting, less than two percent of the total anopheline catch was *A. lungae*. In routine night catches for anophelines in the Lunga district of Guadalcanal the percentage of *A. lungae* of the total anophelines collected is a little less than two. Blooded females collected in the jungle near troop areas were dissected. Seventy percent of these showed nucleated red blood cells; the blood found in the remainder was of mammalian origin. Precipitin tests are being made on a small number of blooded females of these species collected by Capt. F. B. Whittington.

It appears from these sketchy observations that in the area in question *A. lungae* is not strongly androphilic and probably is not of primary importance in disease transmission. Nevertheless, during the rainy season when this species is flushed out by the rains and extends its breeding range into the coastal coconut

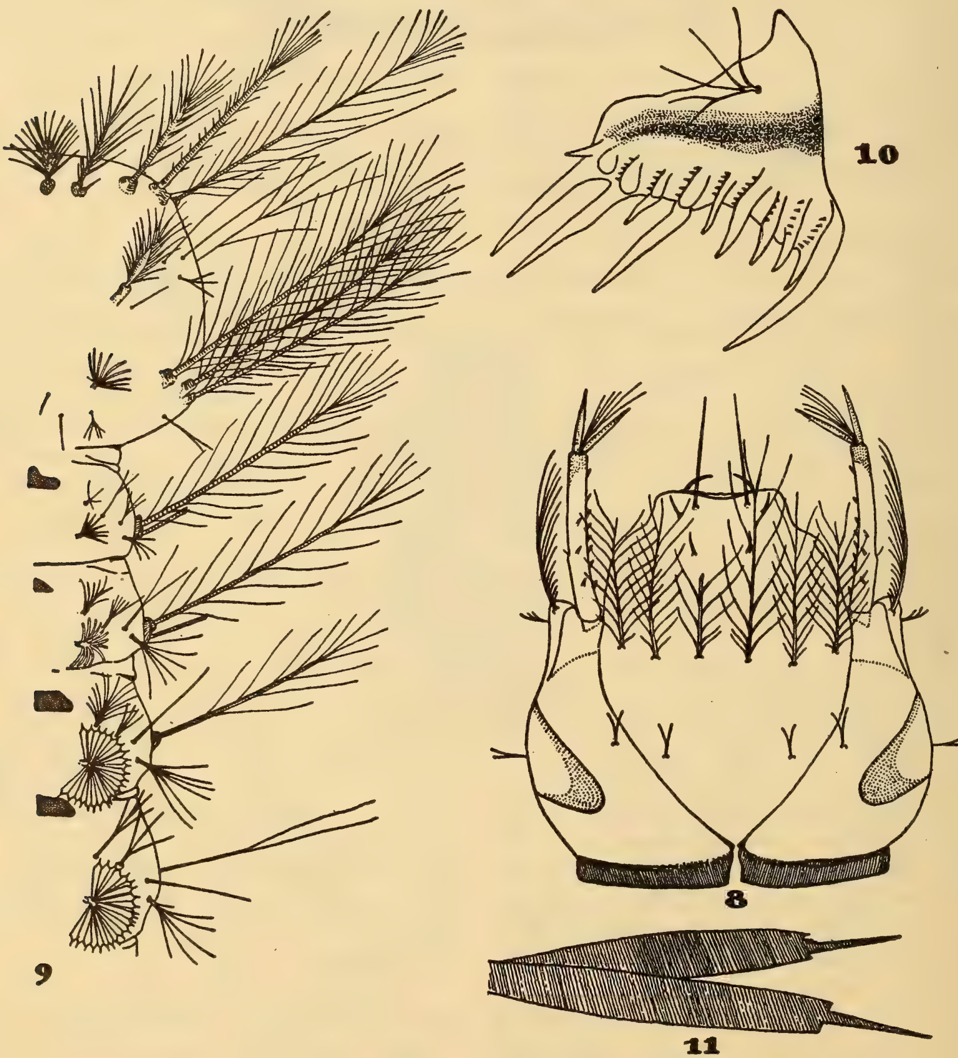
groves it may become a problem locally. The normal blood supply is believed to be birds and possibly bats. With the great disturbance caused by an influx of humans a change in blood feeding habits may take place.

PROVISIONAL KEYS TO ANOPHELINES OF GUADALCANAL ISLAND

The following provisional keys are included as it is hoped that they may be of assistance in other parts of the South Pacific Area. Large series of individual rearings connected the larvae with the adults.

Females

1. Palpi very short, wing scales all dark........ ....*Bironella*(*walchi*?)
   Palpi as long as labium, wing scales light and dark..................................2
2. Mesonotum with a vestiture of golden yellow hairs only, except for white and black scales on anterior promontory; median dark wing spot including subcosta, vein 1, and base of vein 2; apical third of proboscis with yellow



MORPHOLOGY OF LARVA OF ANOPHELES LUNGAE
Fig. 8.—Head. Fig. 9.—Thorax and abdomen. Fig. 10.—Pecten. Fig. 11.—Leaflet of palmate hair.

scales, interrupted by narrow dark ring near apex....................*A. lungae*
Mesonotum with a vestiture of white scales throughout; median dark wing spot not extending to veins 1 and 2..............3
3. Labium all dark except for a few white or yellowish scales at extreme apex...*A. p. farauti*
Labium with a vestiture of white or creamy scales on apical third, interrupted by a narrow ring of dark scales just before apex.... ....*A. p. punctulatus*

Males

The males of the three forms of *Anopheles* in this area have the labium all dark with a few light scales on apex; the labella are dull yellow. The males of *A. lungae* can be distinguished on mesonotal vestiture and wing spotting which are similar to the female. The males of *A. p. punctulatus* and *A. p. farauti* have not as yet been successfully separated.

Larvae

1. Inner clypeals close together.*Bironella*(*walchi*?)
Inner clypeals widely separated............2
2. Outer clypeals extremely short, usually less than one quarter the length of inner clypeals; pecten with two distinct series of spines, spines 10–12 in number; palmate hair on II not pigmented.........*A. lungae*
Outer clypeals at least half as long as inner clypeals; pecten with 14–17 subequal spines 3
3. Clypeal hairs slender, without branches; prothoracic hairs 1 and 2 with rather slender shafts, hair 5 with long lateral branches; palmate hair on II less developed than on III; lateral hairs on IV and V with three to four branches.........*A. p. punctulatus*
Clypeal hairs thickened, with a few fine lateral branches; prothoracic hairs 1 and 2 with thickened shafts, hair 5 with very short lateral branches; palmate hair on II developed as strongly as on III; lateral hairs on IV and V simple or double..*A. p. farauti*

Remarks.—The larvae of *A. p. punctulatus* from Guadacanal agree in every respect with the chaetotaxy represented for this form in Ross and Roberts' "Mosquito Atlas," Part 2, p. 12, 1943. Adults of *A. p. punctulatus* have never been collected attempting to bite humans on this island.

ENTOMOLOGY.—*Some relationships of* Anopheles lungae *Belkin and Schlosser* (*Diptera: Culicidae*).[1] ALAN STONE, U. S. Bureau of Entomology and Plant Quarantine.

The foregoing excellent description of *Anopheles lungae* is sufficient to distinguish it from all other described species, but it seems advisable to compare it with certain closely related species that were not available to its describers. This is particularly true since it might be confused with *Anopheles tessellatus* Theobald or *A. longirostris* Brug. These three species have the following characters in common which distinguish them from the related species, *punctulatus* Dönitz, *annulipes* Walker, *farauti* Laveran, and *amictus* Edwards: (1) Scales of the halteres entirely pale, creamy white; (2) scutum with scales on the anterior margin only; (3) outer clypeal hairs of the larva very short, much less than half as long as the inner clypeal hairs.

The females of the two close relatives of *lungae* are distinguished from it by the following characters:

A. longirostris: At least apical half of proboscis pale; proboscis about one-fifth longer than the palpi, strongly decurved; third palpal segment (antepenultimate) with apical half pale.

A. tessellatus: Third palpal segment with apical half pale.

The larva of *lungae* closely resembles that of *tessellatus*, but prothoracic hair 1 of *tessellatus* has a slender shaft with 2–6 branches. The larva of *longirostris*, as described, shows no differences from *lungae*, but it is quite probable that a direct comparison of the two species will reveal some.

The distribution of these three species is of some interest in view of their close relationship. *A. tessellatus* has a wide Oriental distribution from India to Hong Kong, the Netherlands Indies, the Philippines, with a few records from the Moluccas, and one questionable one from western New Guinea. *A. longirostris* has been collected from several places in New Guinea and from Kavieng, New Ireland. *A. lungae* is confined to the Solomon Islands. The distribution of the three species has not yet been found to overlap.

[1] Received June 29, 1944.

ICHTHYOLOGY.—Sphyrna bigelowi, *a new hammerhead shark from off the Atlantic coast of South America, with notes on* Sphyrna mokarran *from New South Wales.*[1] STEWART SPRINGER, Homestead, Fla. (Communicated by LEONARD P. SCHULTZ.)

During a study of sharks in the collections of the Museum of Comparative Zoology, Dr. Henry B. Bigelow and William C. Schroeder found a single specimen of a hammerhead shark that they recognized as belonging to an undescribed species. Subsequently, when I found two specimens of this species in the United States National Museum collections, descriptive data and drawings of the M.C.Z. specimen were generously furnished by the discoverers. It gives me great pleasure to name this new hammerhead in honor of Dr. Bigelow in recognition of his part in the preparation of the important work on sharks in the forthcoming volume, "Fishes of the Western Atlantic."

Sphyrna bigelowi, n. sp.

Holotype.—Young male, about 385 mm in total length, collected by Dr. W. L. Schmitt on the coast of Uruguay, U.S.N.M. No. 87682.

Paratypes.—Young male about 395 mm, from the coast of Uruguay, U.S.N.M. No. 120751; female about 900 mm in total length, from Rio de Janeiro, Brazil, M.C.Z. No. 463.

Description.—Moderate size at birth (smaller at birth than *Sphyrna tudes* (Cuvier), *S. zygaena* (Linnaeus), or *S. diplana* Springer, but larger than *S. tiburo* (Linnaeus); body compressed, proportionately shorter bodied than other hammerheads; head flattened and expanded to form the hammer characteristic of genus; anterior margin of head divided by slight indentations into four lobes between the nostrils; deep groove (not visible from directly above or below) running from each nasal notch toward midpoint in forward margin of head for length of lobe adjacent to nostril; greatest width of head in smaller (newborn) individuals about 16 per cent and about 23 per cent of total length in largest (900 mm) specimen; anterior margin of head of smaller specimens rounded, that of large specimen less rounded; length of snout (distance from front of mouth to midpoint in front margin of the head) about 10 per cent of total length in smaller individuals and about 7.3 per cent in largest specimen; greatest length of expanded portion of head of smaller individuals about 50 per cent of its greatest width and in largest one about 40 per cent; posterior edge of hammer of young with relatively long trailing flap without cartilaginous support, this structure reduced in larger specimen; mouth broadly rounded and well back in head, a transverse line through front of mouth passing posterior to the eyes, a line through corners of mouth passing posterior to hinder edge of hammer in largest specimen but not posterior to trailing edge of hammer in young; eye small, its diameter about 1.5 per cent of total length in smaller specimens and proportionately smaller in the largest specimen; eye separated from nasal notch by a distance little greater than diameter of eye; gill openings of moderate length, first three nearly equal, last two a little shorter; last gill opening over insertion of pectoral; fins large, their distal (trailing) margins slightly concave except in pelvic fins which are rounded; caudal region heavy and compressed, caudal pits well developed; first dorsal fin high, roughly triangular, its origin behind axil of pectoral but in advance of free inner angle of pectoral; posterior lobe of first dorsal extending to a point over insertion of pelvics; no skin ridge along back between dorsal fins; second dorsal fin relatively high, its area about half that of anal fin; origin of second dorsal over middle of base of anal, and posterior lobe reaching a point about opposite posterior tip of anal but posterior tip of second dorsal when lifted upward not reaching a point much higher than apex of fin; base of anal fin long, with distal margin (free edge) not deeply incised, and apex a rounded point not greatly projecting; teeth in $\frac{16-0-16}{16-1-16}$ rows in types; all teeth without serrations; teeth of upper jaw narrowly triangular mostly directed toward corners of mouth and deeply notched on outer margins; teeth of lower jaw with narrower and more erect cusps, the latter only slightly pointing toward corners of mouth even in young;

[1] Received June 22, 1944.

base of lower symphyseal tooth and next four rows of lower jaw teeth with sharp shoulders in young; the sharp shoulders present only on symphyseal and first adjacent row of teeth in larger individual; fifteenth and sixteenth rows of teeth of lower jaw in the three type specimens without cusps.

Color.—In alcohol, grayish above and lighter below, no prominent contrasting markings except narrow yellowish border along anterior edge of hammer and yellowish cast to trailing edge of hammer in young (coloration possibly owing to preservation).

Comparison with other species.—If the diagnosis of the type material of *bigelowi* is correct, striking change in the shape of the head with growth is shown. All hammerheads, as judged by the material available for study show a tendency toward widening and shortening of the head with increase in size, and old adults of *bigelowi* may have the forward margin of the head nearly straight. The young of *S. tudes* have longer heads with more rounded anterior margins, but heads of the adults are nearly transverse. *S. bigelowi* and *S. tudes* are similar in regard to their small eyes, high second dorsal fins, and large mouths placed well back in head. *S. bigelowi* differs from *S. tudes* in having smooth instead of serrate teeth, a deep groove instead of a very shallow one in front edge of head, in the young having a long trailing edge of unsupported skin posteriorly along hammer. *S. bigelowi* has the smallest eye among all the species of the genus.

The combination of a deep groove along front margin of head and a relatively high second dorsal fin is not known in any other hammerhead shark. *S. bigelowi* differs from *S. zygaena* and *S. diplana* in having a higher second dorsal fin with a shorter posterior lobe instead of a lower fin with a longer posterior point. *S. bigelowi* has a low, long anal fin with its apex moderately projecting, whereas *S. tudes*, *S. zygaena*, and *S. diplana* have the anal

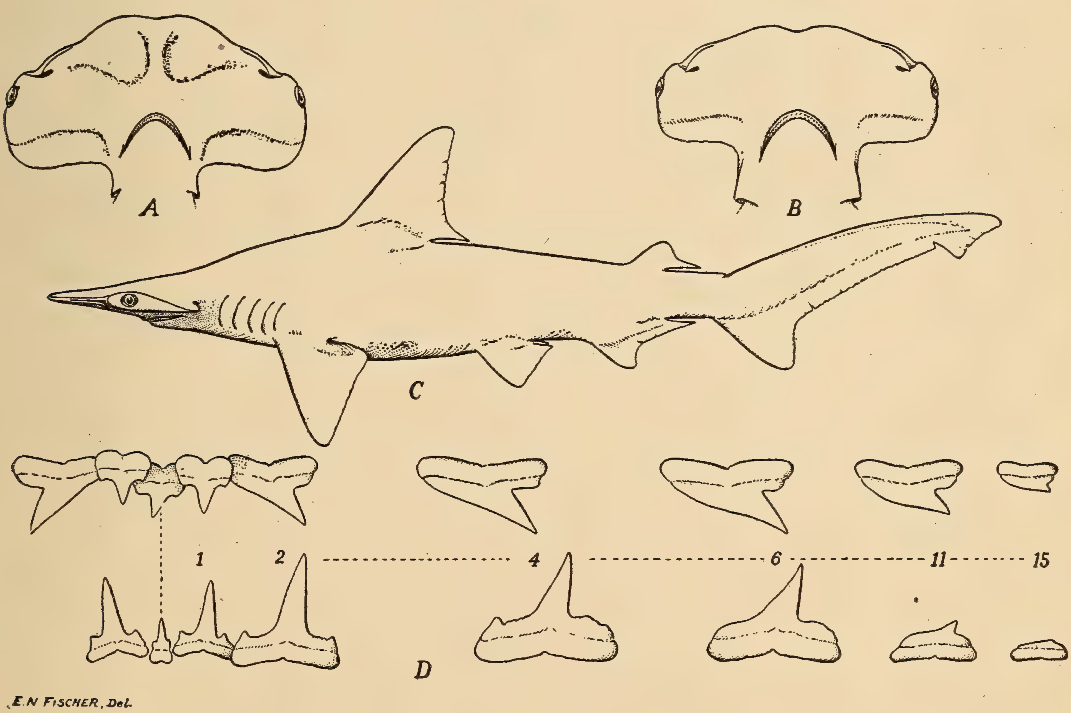


Fig. 1.—*Sphyrna bigelowi*, n. sp.: *A*, Lower side of the head of the holotype, U.S.N.M. No. 87682, a male, 385 mm in total length (the dotted lines mark the area of the trailing flap of the hammer); *B*, Lower side of the head of the 900-mm female; *C*, Lateral view of the holotype; *D*, Teeth of the 900-mm female; the lower symphyseal tooth, the first upper tooth of the right side of the jaw, and the upper and lower teeth of the left side of the jaw in the (1), (2), (4), (6), (11) and (15) rows are represented. Drawings by E. N. Fischer.

fin deeply incised distally, with the apex of the fin forming a distinct hook.

Sphyrna lewini (Griffith), *S. oceanica* (Garman), and *S. zygaena* are names that have been used for Pacific hammerheads. Regardless of the validity of these names the species represented all have small, low second dorsal fins with long posterior points, and thus differ from *S. bigelowi*. The Pacific species, *S. blochi* (Cuvier), *S. media* Springer, *S. corona* Springer, and *S. vespertina* Springer, and the Atlantic *S. tiburo* may be distinguished from *S. bigelowi* by the shape of the head.

Sphyrna mokarran (Rüppell) of the Red Sea, Indian Ocean, and the southwest Pacific Ocean is rare in collections and is not adequately described in the literature so it seems advisable to make a few notes here. Measurements of a female embryo of this species in fair condition, U.S.N.M. No. 40026, from Richmond River, New South Wales, February 7, 1889, are given in Table 1. Another specimen, 290 mm long, in poor state of preservation, U.S.N.M. No. 12622 from Madras, is tentatively identified as *S. mokarran*. *S. mokarran* is similar to *S. tudes* and *S. bigelowi* in having—a high second dorsal fin with a short posterior lobe, and a relatively large mouth placed well back in the head. The anterior margin of the hammer of the embryo of *S. mokarran* is nearly straight across and the groove in the front edge is a fine line quite unlike the prominent deep groove of *S. bigelowi* or the shallow indistinct groove of *S. tudes*. The eyes of the embryo of *S. mokarran* are large, about 2.6 per cent of the total length. The anal fin is hooked at its apex and its origin is only slightly in advance of the origin of the second dorsal.

Table 1.—Measurements (in mm) of Sphyrna bigelowi, n. sp. and S. mokarran (Rüppell)

Characters	*S. bigelowi*	*S. bigelowi*	*S. mokarran*
	Young male, U.S.N.M. No. 87682	Young male, U.S.N.M. No. 120751	Embryo female, U.S.N.M. No. 40026
Total length (in mm)	385	395	415
Length upper caudal lobe	115	118	130
Greatest width hammer	122	125	102
Greatest length hammer	61	64	43
Horizontal diameter orbit	6	6	10
Vertical diameter orbit	6	6	10
Width mouth	26	26	31
Internasal distance	89	91	73
Length nasal aperture	10	11	7
Tip of snout to:			
Front of mouth (length snout)	39	40	32
First gill opening	75	80	78
Base pectoral	97	97	90
Anus	172	180	200
Origin first dorsal	124	128	126
First dorsal fin:			
Anterior margin	64	63	70
Posterior margin	16	17	14
Base	37	37	40
Interdorsal distance	82	79	86
Second dorsal fin:			
Anterior margin	18	19	24
Posterior margin	17	18	21
Base	16	17	20
Pectoral fin:			
Anterior margin	50	52	48
Inner margin	20	21	17
Base	20	19	20
Anal fin:			
Anterior margin	21	20	22
Posterior margin	12	14	17
Base	32	31	24

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PHYSICS.—*Altitude by measurement of air pressure and temperature.*[1] W. G. BROMBACHER, National Bureau of Standards.

Measurement of differences in elevation of points on the earth's surface by measuring the atmospheric pressures at the two points is quite old. However, all the additional factors entering into a determination, such as air temperature, humidity, and gravity, were not completely understood until the French mathematician Laplace published the complete formula which bears his name, at least in France.

Until the invention of the aneroid barometer by Vidi in 1847 it was necessary to make the pressure measurements by means of the mercury barometer, which is inconvenient to transport from place to place. The early aneroid instruments were in general unreliable, and progress was slow in eliminating or reducing to reasonable values their many sources of error. However, the elements of the aneroid barometer remain unchanged, although design and workmanship have improved greatly. The advent of the aneroid barometer made convenient the use of this method of measuring altitude.

It should be stressed at the start that the altimeter or aneroid barometer can be used only to measure differences in altitude or elevation. Some base pressure or reference level is assumed either explicitly or implicitly. When the auxiliary altitude scale of the aneroid barometer or the scale of the altimeter is set to zero, it is implied that the subsequent altitude reading of the instrument is above or below the pressure corresponding to the zero reading.

The terms "altimeter" and "aneroid" barometer are often used interchangeably. Both are instruments which measure absolute air pressure. When the pressure scale is graduated in evenly divided pressure units, the instrument will be called an aneroid barometer. It may have an auxiliary altitude scale, but this will be necessarily unevenly divided. On the other hand, when called an altimeter the instrument will have an altitude scale that is graduated in evenly divided units in accordance with the pressure-altitude relation of a selected standard atmosphere. It also may have an auxiliary pressure scale and means for adjusting the zero reading. There is no other fundamental difference in the two instruments.

Almost by necessity a choice must be made between two distinct procedures in measuring altitude by the barometric method. In the first, the air pressures, air temperatures, and other required quantities are measured and the basic formula used to compute the altitude. This procedure usually is followed in cases where the pressure observations are recorded and is customarily used in the computation of atmospheric soundings by meteorologists who have developed short cuts in the computation, which will not be discussed here. It is relatively laborious and time consuming.

In the other procedure, altitude is measured with an altimeter, calibrated to the altitude-pressure relation of a standard atmosphere. In accurate work, additional quantities are observed for use in applying the corrections for deviations in air temperature, humidity, etc., from the assumed standard conditions. The altimeter is used

[1] Address of the retiring president of the Philosophical Society of Washington, delivered at the 1211th meeting of the Society, January 16, 1943. Received April 11, 1944.

both in aircraft during flights and in surveys on land when surveys by transit are not feasible.

We proceed now to a brief discussion of the fundamental formula.

THEORY

Altitude is determined by the following formula (see references 1, 2):

$$H = \int \frac{dP}{g\rho} = KT_m\left[1+0.376\left(\frac{e}{P}\right)_m\right] \cdot \left[1+\frac{g_s-g_m}{g_s}\right]\log\frac{P_1}{P_2} \qquad (1)$$

$$T_m = \frac{\int_{\log P_1}^{\log P_2} Td(\log P)}{\log P_1 - \log P_2} = \frac{\sum T_n}{n} \qquad (2)$$

The constant $K = 221.152$ for H in feet and 67.4073 for H in meters.

H = altitude above the pressure level P_1.

P_1 = pressure at ground level.

P = pressure at intermediate levels.

P_2 = pressure at upper level; all in the same units of pressure;

ρ = air density;

T_m = mean temperature in °K(= 273 + t°C) of the air column between pressure levels P_1 and P_2.

T_n = the air temperature at equally spaced intervals of $\log P$ or $K \log (P_1/P_2)$ between P_1 and P_2.

n = number of selected equal intervals between P_1 and P_2.

e = water vapor pressure in same units as P.

$(e/P)_m$ = mean value for air column between P_1 and P_2.

g_s = standard value of gravity.

g_m = value of gravity at the midpoint of the air column between P_1 and P_2.

The altitude above sea level equals $H+h$ where h is the elevation above sea level of the lower pressure level.

The formula as given involves the following assumptions:

(*a*) Air obeys the gas law, $pv = mRT$.
(*b*) The composition of the atmosphere is the same at all altitudes.
(*c*) The air is in vertical equilibrium, i.e., no vertical currents.

The following values of the constants were used in evaluating K:

(*a*) Air density at 0°C and 760 mm of mercury, 1.2930 kg/m³.
(*b*) Standard value of gravity, 980.665 cm/sec².
(*c*) Density of mercury at 0°C, 13.5951 g/cm³.
(*d*) The air is assumed dry.

Formula (1), or its equivalent forms, is used in making precise determinations of the altitude. The necessary observations are:

(*a*) The air pressures at the lower and upper levels, measured simultaneously and on the same vertical line, or corrected to obtain simultaneity and verticality.

(*b*) The air temperature and corresponding air pressure at intervals from the lower to the upper level, also measured or corrected to obtain simultaneity. The intervals must be sufficiently close to obtain an accurate picture of the temperature distribution.

(*c*) The humidity, and the corresponding air temperature and air pressure, measured at intervals from the lower to the upper level.

(*d*) The values of gravity at the lower and upper level obtained usually by computation from available data.

Since the atmosphere is not generally in equilibrium, the air pressure, temperature, and humidity vary with time and place, and since observations of these elements in general can not be made simultaneously in the same vertical line, consideration must be given to methods of correcting the observed data. First, observations should be made, when possible, when atmospheric conditions are reasonably stable; observations during line squalls, wind shifts, and thunderstorms should be avoided.

Continuous measurements of the air pres-

sure and air temperature at the lower level may be made in a net around the point at which the pressure at the upper level is measured, in which case the proper pressure and temperature at the lower level are obtained by interpolation in time and location. Since the above procedure is often impracticable, the air pressure and temperature are usually measured continuously at one point only, in which case the observations available are used as circumstances permit, to bring the pressures and temperatures at the two levels into simultaneity and verticality. Field conditions under which observations are made, either in surveying or in aircraft flights, are far from ideal, so that some data are often lacking; in this case the computer can usually fill the gap from routine observations by the Weather Bureau office serving the locality.

The required temperature observations offer more difficulty than those of pressures; first, because the temperature changes more rapidly with time, especially near the ground; and second, because, particularly in surveying, the air column is often fictitious, that is, the lower or reference level vertically below the point of observations at the upper level is underground. There is further the fact that local thermal gradients exist near the ground, particularly in broken country, which introduce inaccuracy into the determination of mean temperature. It may be stated here that air currents along the ground which arise from thermal gradients have a vertical component on mountain sides, and therefore introduce errors into the altitude determination, found by Rühlman (*1*)[2] to be of the order of 2 percent.

It is obvious from the foregoing that the time interval between the initial observations at the lower level and the final observations at the upper level should be as short as possible.

The observations to obtain the humidity term in formula (1) require only that of humidity in addition to those of temperature and pressure already discussed. Fortunately, the humidity term is of minor importance, rarely exceeding 1.0 percent in amount, at summer temperature, and rapidly reducing in amount with reduction in air temperature. In surveying, its measurement to sufficient accuracy offers no difficulty and may often be made only at the lower level station without loss in accuracy.

[2] Italic numbers in parentheses refer to literature cited at end of paper.

Approximate altitude formula.—In many cases pressure and temperature data are sufficient for the accuracy required or are all that are available. The altitude is then given by

$$H = KT_m \log \frac{P_1}{P_2}, \tag{3}$$

where the notation is as given for formula (1) and the observations needed are those listed under (*a*) and (*b*) above.

Alternate form of formula.—Meteorologists commonly use formulas (1) and (2) in somewhat different form, so that the computations can be made in steps up to the highest altitude. This is, neglecting gravity and humidity correction terms, which are the same as given in formula (1),

$$H = \sum_1^n h = K \sum_1^n T_m \log \frac{P_r}{P_s}, \tag{3a}$$

where n equals the number of intervals in the air column between P_1 and P_2 usually divided at points where the rate of change of temperature with respect to log P, or lapse rate, changes in value.

$$T_m = \frac{T_r + T_s}{2}.$$

T_r and T_s are the temperatures in °K at the lower and upper levels of each altitude interval respectively.

P_r and P_s are the air pressures corresponding to T_r and T_s. Discussion in this paper will be limited to formulas (1) and (3).

Computation of mean temperature.—To compute the mean temperature from adequate observations, when the altitude to be determined is large, say above 500 to 1,000 feet, plot the observed temperature at pressure P against log P or K log (P_1/P), whichever is more convenient (*2*). It is evident from formula (2) that the mean temperature is the area included in the curve and

the ordinate $T=0$, divided by $\log P_1 - \log P_2$. The area can be determined by a planimeter or by graphical integration. The computation is made more conveniently by other methods. If the curve is linear, the mean temperature is the temperature at the midpoint of the log P ordinate. Otherwise, divide the curve into a number of equal intervals of log P. The decision as to the number of intervals n is a matter of judgment based upon the degree of irregularity of the temperature curve and a balance of the accuracy of the data against the accuracy of the determination. The more intervals, the greater the possible precision. For each interval of log P the mean temperature is obtained by inspection, and usually is the temperature at the midpoint. The average of the mean temperatures T_n of the intervals is the mean temperature T_m of the air column.

When the altitude difference is small, it is often sufficiently accurate to take as the mean temperature the air temperature measured at the place and time of measurement of the pressure P_2. As a further refinement the average of the temperatures measured simultaneously with P_1 and P_2 at the two points of observation can be taken as the mean temperature.

Methods of computing approximately the mean air temperatures for large altitude differences have been proposed and are in use mainly because of difficulty, or possibly negligence, in obtaining the data necessary for an accurate computation. All these methods give mean temperatures which are more or less inaccurate when a temperature inversion exists in the air column between pressure levels P_1 and P_2, or in general if the temperature lapse rate is not constant between P_1 and P_2.

A commonly used approximation is

$$T_m = \frac{T_1 + T_2}{2} \qquad (4)$$

where T_1 and T_2 are the temperatures measured at levels P_1 and P_2 respectively.

Another approximation is

$$T_m = T_1 - \frac{aZ}{2} = T_2 + \frac{aZ}{2} \qquad (5)$$

where a is an assumed temperature lapse rate, commonly 2°C. per 1,000 feet, and Z, the altitude in the standard atmosphere to which the altimeter is graduated.

It will be seen that formula (4) involves making only two observations of temperature, and formula (5) one observation, either at level P_1 or P_2, usually most conveniently at P_2.

There is also another approximation which may be of value in aircraft because of relative ease in computation. This is

$$T_m = \frac{T_1 + T_2 + T_3 \cdots T_n}{n} \qquad (6)$$

where T_1 and T_n are the air temperatures at the lower and upper levels respectively, and T_2, T_3, etc. are temperatures at intermediate levels, equally spaced in altitude, as measured by an altimeter.

Humidity correction.—The additive correction C_h for humidity is given by the relation

$$C_h = 0.376 \left(\frac{e}{P}\right)_m H_c \qquad (7)$$

and the altitude H determined by pressure, temperature and humidity is

$$H = H_c + C_h$$

where $(e/P)_m$ is the mean value of the ratio of the water vapor pressure to the corresponding air pressure and H_c is the altitude determined by the pressure and temperature data.

The magnitude of the humidity correction given by formula (7) for the case when the relative humidity is 100 percent and for five ground level temperatures is given in Fig. 1. The temperature lapse rate is assumed the same as for the U. S. standard atmosphere, that is, 1.98°C. per 1,000 feet. Lines showing a correction of 0.5 and 1 percent of the altitude H_c are also shown on the chart.

It is seen that the amount of humidity correction rises rapidly with air temperature and that the error tends to become constant in amount at high altitudes and low ground level temperatures. The actual humidity corrections are less than those shown in Fig. 1, since 100 percent relative

W. G. Brombacher, retiring president, Philosophical Society of Washington, 1942.

humidity at all altitudes is not common.

Actually the vapor pressure of water in the atmosphere tends to remain constant for a considerable altitude, but the relative humidity increases up to the altitude at which condensation takes place, indicated by the presence of a cloud. This fact makes it possible to calculate with some accuracy from one value of the relative humidity the humidity corrections for moderate altitudes, not exceeding as a maximum the height of the underside of the cloud layer.

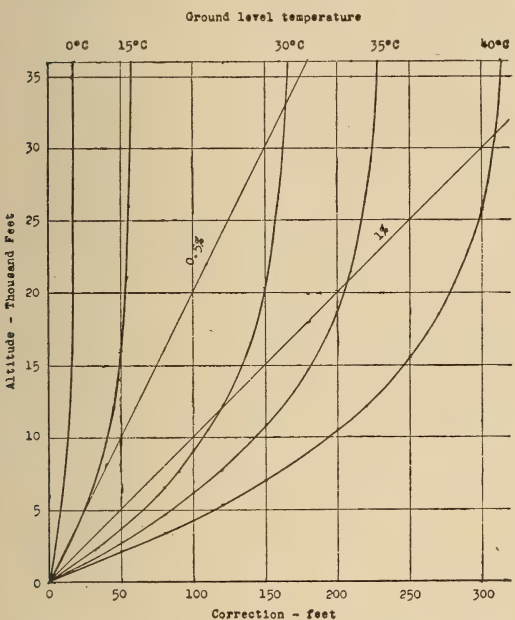

Fig. 1.—Humidity correction $C_h = 0.376(e/p)_m H_c$ for saturated air. The air temperature $t = t_0 - .00198h$, where t_0 is the air temperature at the ground level marked on the particular curve and h is the altitude. The straight lines give the humidity correction as a designated percentage of the altitude.

Gravity correction.—The correction for deviation from standard gravity, g_s, 980.665 cm/sec² is as follows:

$$C_g = \frac{g_s - g_m}{g_m} H_c \tag{8}$$

where g_m is the mean value of gravity for the air column and H_c is the altitude determined by pressure, temperature, and humidity measurements. The altitude H corrected for temperature, humidity, and gravity is $H = H_c + C_g$

The mean value of gravity equals

$$g_m = g_l - \frac{K(H+2h)}{2} \tag{9}$$

where g_l is the gravity at sea level, obtained from observed or computed data published in the Smithsonian Meteorological Tables (*3*) or by the U. S. Coast and Geodetic Survey; h is the elevation above sea level of pressure level P_1; $(H+h)$ is the elevation above sea level of pressure level P_2, practically H_c+h; and K is a constant which equals 0.000094 (*3*) when H and h are in feet.

The corrections at the Equator, at latitude 45°, and at the poles are as follows for the case where h is zero:

GRAVITY CORRECTION, C_g

Altitude	Equator		Latitude 45°		Pole	
Feet	*Feet*	*%H*	*Feet*	*%H*	*Feet*	*%H*
1,000..	+ 2.7	+0.27	+ 0.1	+0.009	− 2.5	−0.25
20,000..	+ 74	+0.37	+20	+0.098	−32	−0.16
30,000..	+123	+0.41	+43	+0.145	−36	−0.12

Accuracy of barometric formula.—The question arises naturally as to the accuracy of the barometric formula. This question has been considered by a number of investigators, notably Rühlman (*1*), who checked the formula for two years in the Swiss Alps. In 1935 a balloon flight to 72,395 feet was made by Maj. A. W. Stevens and Capt. O. A. Anderson under the auspices of the National Geographic Society and the Army Corps. During the latter flight accurate and complete barometric data were obtained, and photographs made vertically downward from the balloon, from both of which the altitudes were determined. The balloon altitudes were also measured by triangulation from the ground. A comparison of the data given by Brombacher and Houseman (*4*) is shown in Fig. 2. About 60 photogrammetric and 11 triangulation altitudes are shown in the figure against a curve of balloon altitude against time determined from the barometric data.

The agreement in the altitudes by the three independent methods is quite good and leads to confidence in the barometric

method up to at least 72,000 feet. Comparing the photogrammetric and the barometric altitudes, the average difference is 0.36 percent; on the average the barometric altitude is 93 feet lower.

Standard atmospheres.—Since aneroid barometers and altimeters are primarily pressure measuring instruments, it is essential to choose some altitude-pressure-temperature relation to which they can be calibrated in units of altitude. A large number of these relations, based on a selected condition of the atmosphere, known as a standard atmosphere, have been and are being used. For aviation altimeters, the standard atmospheres now in use are national or international standards; for aneroid barometers and surveying altimeters the standard atmosphere has been selected by the manufacturer or the buyer and, in one case, Germany, it is the national standard.

In general, aneroid barometers equipped with an altitude scale which are commercially available in this country and Great Britain are calibrated to Airy's pressure altitude relation; some are calibrated to the obsolete United States altimeter calibration standard; and others bought under Government specifications are calibrated to the altitude-pressure relation for English units given in the Smithsonian Meteorological Tables. The latter instruments are, strictly speaking, altimeters, but are used only on the ground. In addition to the above calibration standards, there is also another, found on Paulin aneroid barometers made in Sweden, of which there are a number in this country. However, some Paulin instruments in use in this country are calibrated to one of the other above-mentioned relations. The German calibration standard was adopted as the national standard on October 1, 1929. It should be stated that the altitude-pressure relations considered here do not by any means exhaust the list of those used; others are in use in France and Italy.

It may thus be necessary to determine the altitude-pressure relation to which an aneroid barometer or altimeter has been calibrated, particularly if corrections for air temperature deviation from the value assumed in the standard are to be applied, or, in fact, if accurate altitudes are desired. This can be done quite conveniently if the aneroid barometer, or altimeter, has both

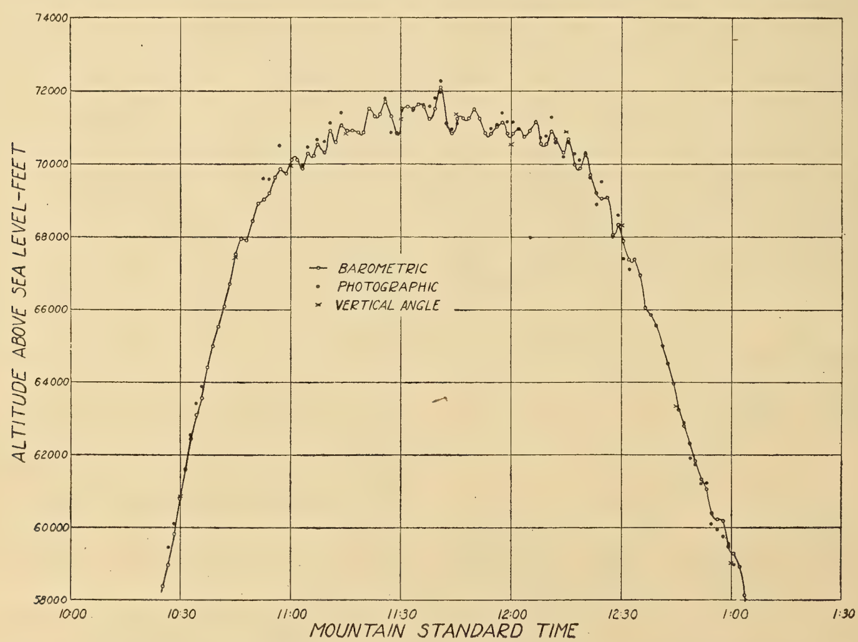

Fig. 2.—A comparison of altitudes of stratosphere balloon Explorer II determined by the barometric formula, by vertical camera photographs, and by theodolite observations.

an altitude and pressure scale. In this case, values of the altitude from the barometer can be checked against values at the same pressure in available tables.

The situation for aviation altimeters is comparatively quite simple. The standard atmosphere adopted by the International Commission for Aerial Navigation (ICAN) in 1924 is used with some modifications, usually minor, by the United States, British Empire, France, Germany, Italy, Japan, and perhaps other nations.

The formulas and constants defining these various standard atmospheres are given below, together with equivalent formulas to facilitate easy comparison. The standard value of gravity given for each atmosphere enters into the evaluation of the constant term or exponent of the altitude formula.

Notation.—In the formulas for the standard atmosphere the symbols have the following definitions:

Z = altitude in the standard atmosphere; if measured above standard ground level pressure P_0 it is called pressure altitude.

P = air pressure at altitude Z.

P_0 = air pressure at ground level of standard atmosphere.

g_s = standard value of gravity.

ρ_0 = density at ground level of standard.

T_{ms} = mean temperature of air column between P and P_0 in standard.

T_s = temperature of air at altitude Z.

a = standard rate of decrease of temperature with altitude Z, or the lapse rate.

Smithsonian.—Altitude-pressure tables in English units given in the Smithsonian Meteorological Tables (*3*) are computed from the following formulas and constants:

$$Z = 62583.6 \frac{T_{ms}}{283} \log \frac{P_0}{P} \text{ feet} \qquad (10)$$

$T_{ms} = 283\ °\text{K}$

$P_0 = 29.90$ inches of mercury $= 759.46$ mm of mercury

$= 1012.53$ millibars (mb)

$g_s = 980.665\ \text{cm/sec}^2$

$\rho_0 = 1.293\ \text{kg/m}^3$ at 0°C. and 760 mm of mercury

Note that $T_{ms}/283 = 1$. This term is retained in the formula in order to facilitate comparison with other standard atmospheres.

If T_{ms} is in °R ($459.4 + t$°F.), the temperature term 283 in formula (10) becomes 509.4 °R. To obtain Z in meters, change the constant 62583.6 to 19075.5. Dry air has been assumed.

Altitude pressure tables are also given based on $P_0 = 760$ mm of mercury and $T_{ms} = 273$°K (0°C.), but no case of surveying altimeters calibrated to these tables is known.

Airy.—The altitude-pressure relation proposed by Sir George Airy (*5*) in 1867 is unique in that a high value of the pressure was taken at zero altitude in order to avoid minus altitudes under ordinary conditions of use.

$$Z = 62759 \frac{T_{ms}}{283} \log \frac{P_0}{P} \text{ feet} \qquad (11)$$

$T_{ms} = 283\ °\text{K}$

$P_0 = 31.00$ inches of mercury.

The constant 62759 is about 0.3 percent higher than that now accepted for formulas based on dry air; therefore altitudes indicated on instruments calibrated to it should be reduced by 0.3 percent, if accurate values are desired, as would be the case if temperature and other corrections are applied.

Obsolete U. S. Aeronautic.—This altitude-pressure relation, used before 1926 (*2*) in calibrating aviation altimeters, has been and perhaps still is used for calibrating altimeters and aneroid barometers used in altitude measurement in surveying. It is defined below:

$$Z = 62900 \frac{T_{ms}}{283} \log \frac{P_0}{P} \text{ feet} \qquad (12)$$

$T_{ms} = 283\ °\text{K}$

$P_0 = 29.90$ inches of mercury.

The relation is the same as that given in the Smithsonian Meteorological Tables except that the constant 62583.6 was increased 0.5 percent to include a correction for "average" humidity. At winter temperatures this correction is too high; at summer temperatures, too low. Therefore, if readings from instruments so calibrated are to

be corrected for all errors, it is best to start by deducting 0.5 percent from the indicated altitude.

Paulin (Swedish).—This calibration may be defined as follows:

$$Z = 62796 \frac{T_{ms}}{283} \log \frac{P_0}{P} \text{ feet} \tag{13}$$

$T_{ms} = 283$ °K

$P_0 = 762$ mm of mercury

It will be seen that the constant 62796 is 0.33 percent higher than the value given for formula (10). The remarks made under formula (12) apply.

German (surveying instruments).—This standard was officially adopted (*6*) for calibrating aneroid barometers and altimeters for surveying on October 1, 1929, but is limited to 5,000 meters. This standard was also used to calibrate aviation altimeters with an altitude limit of 10,000 meters (32,808 feet), but has been superseded for this purpose by the ICAN. The definition follows:

$$P = 762\left(1 - \frac{0.005Z}{283}\right)^{6.83} \quad (Z \text{ in meters}) \tag{14}$$

or

$$Z = 62603 \frac{T_{ms}}{283} \log \frac{P_0}{P} \text{ feet} \tag{15}$$

$T_s = 283 - 0.005Z$ °K

$P_0 = 762$ mm of mercury

$g_s = 980.6$ cm/sec^2

The value of the constant 62603 differs from the accurate value given in formula (10) by 0.03 percent, which is negligible for most purposes.

ICAN standard. — This standard (*7*) adopted by the International Committee for Aerial Navigation is the basis of the standards now generally used for calibrating altimeters. Most countries have made only minor modifications, so that for most practical purposes the same standard can be said to be used by all. It is defined here for reference.

Up to 11,000 meters (36,089 feet):

$$\frac{P}{P_0} = \left[\frac{T_s}{288}\right]^{5.256} \tag{16}$$

$$T_s = (288 - aZ) \text{ °K} \tag{16a}$$

$$a = 6.5\text{°C/km} = 0.0019812 \text{ °C/foot} \tag{16b}$$

$$P_0 = 760 \text{ mm of mercury} \tag{16c}$$

Above 11,000 meters:

$$Z = 11000 + 14600 \log \frac{P_{11}}{P} \text{ meters} \tag{17}$$

$T_s = -56.5$°C.

$P_{11} = 169.595$ mm of mercury (at 11,000 m).

For all altitudes:

$g = 980.62$ cm/sec^2

U. S. Aeronautic.—This standard atmosphere (*8*) (*9*), used since 1926 in calibrating aviation altimeters, and also adopted as the standard atmosphere for all aeronautic purposes in the United States, is a slight modification of the ICAN. The air temperature is assumed to vary uniformly with altitude (6.5°C. per km) until a temperature of −55°C. (instead of −56.5°C.) is reached. Above this level the temperature is assumed constant at −55°C. Its definition follows:

Up to 35,332 feet:

$$Z = 63691.8 \frac{T_{ms}}{288} \log \frac{P_0}{P} \text{ feet} \tag{18}$$

or

$$P = P_0\left[\frac{T_s}{288}\right]^{5.2553} \tag{19}$$

$$T_s = 288 - aZ \text{ °K} \tag{18a}$$

$$a = 0.0019812 \text{ °C/foot} = 6.5 \text{ °C./km} \tag{18b}$$

$$T_{ms} = \frac{aZ}{\ln \frac{288}{T_s}} \tag{18c}$$

$P_0 = 760$ mm of mercury $= 29.921$ inches of mercury $= 1013.25+$ mb.

$\rho_0 = 1.2255$ kg/m^3

Above 35,332 feet:

$$Z - 35332 = 48211.1 \log \frac{P_{55}}{P} \text{ feet} \tag{20}$$

$T_{ms} = 218$ °K

$P_{55} = 175.898$ mm of mercury

For all altitudes:

$g_e = 980.665$ cm/sec^2

To compare with the SMT formula (10), formula (18) can be written:

$$Z = 62586.0 \frac{T_{ms}}{283} \log \frac{P_0}{P} \cdot \tag{21}$$

The values of the constants for the two standard atmospheres, 62583.6 and 62586, are in practical agreement, so that altitudes obtained from readings on instruments calibrated to either formula, after applying correction for deviation of actual mean temperature from that of the respective standard, will be in agreement.

The constant K given in formula (1), when multiplied by 283 to obtain the formula in the same form as in formula (21), is also 62586.0.

The altitude in the standard atmosphere defined by formulas (18) and (20), when $P_0 = 760$ mm of mercury, is called the pressure altitude.

British Aeronautic.—This standard atmosphere (*10*) is also a slightly modified version of the ICAN. The air temperature is assumed to vary 1.98°C. per 1,000 feet of altitude, which is not exactly 6.5°C. per km, the ICAN value. Its definition follows.

Up to 36,090 feet:

$$\frac{P}{P_0} = \left[\frac{T_s}{288}\right]^{5.256} \tag{22}$$

or

$$Z = 63721 \frac{T_{ms}}{288} \log \frac{P_0}{P} \tag{23}$$

$$T_s = 288 - aZ \text{ °K} \tag{22a}$$

$$a = 0.00198 \text{ °C/foot} = 6.496 \text{ °C./km} \tag{22b}$$

$$T_{ms} = \frac{aZ}{\ln \frac{288}{T_s}} \tag{23a}$$

$P_0 = 1013.2$ mb $= 760$ mm of mercury

Above 36,090 feet:

$$Z = 36090 + 47900 \log \frac{P_{56.5}}{P} \tag{24}$$

$$T_{ms} = 216.5 \text{ °K} \tag{24a}$$

$P_{56.5} = 226.3$ mb $= 169.7$ mm of mercury

For all altitudes:

$g_s = 980.62$ cm/sec^2

French Aeronautic.—This standard (*11*) was first proposed by Toussaint and adopted in France in 1920. Later the ICAN adopted it, since when it has been known as the ICAN standard. It differs from the ICAN given above only in that the exponent of equation (16) is 5.255, instead of 5.256. For all practical purposes the pressure-altitude tables are identical with those of the ICAN.

German Aeronautic.—This standard atmosphere (*12*) differs from ICAN standard as given in formulas (16) and (17) in that the exponent used is 5.26 instead of 5.256. The air is assumed dry with a specific weight of 1.225 kg/m^3 at sea level. For all altitudes, $g = 980.62$ cm/sec^2.

At 35,000 feet the pressure is 178.5 mm of mercury; this is 0.2 mm of mercury less than in the ICAN standard, equivalent to 24 feet difference at 178.7 mm of mercury. This altitude difference for a given pressure, German compared to ICAN standard, becomes less at lower altitudes but will be constant at 24 feet at altitudes above 35,000 feet.

Japanese Aeronautic.—This standard atmosphere (*13*) is basically the ICAN.

Up to 11,000 meters:

$$P = 760 \left(\frac{288 - 6.5Z}{288}\right)^{5.253}.$$

Above 11,000 meters:

$$Z = 11000 + 14600 \log \frac{P_{11}}{P}$$

$P_{11} = 169.74$ mm of mercury

$T_s = 216.5$°K(-56.5°C.)

At all altitudes:

$g = 980.00$ cm/sec^2, in the altitude formula;

$g = 980.665$ cm/sec^2, for other purposes.

At a pressure of 175.898 mm of mercury, the U. S. altitude is 35,332 feet, the Japanese, 35,346 feet; at 169.74 mm of mercury the U. S. altitude is 36,079 feet, the Japanese, 36,089 feet (11,000 m). The above differences are less at lower, and constant at about 10 feet at greater, altitudes.

Altitude-pressure tables.—Altitude-pressure data for the various altimeter calibration standards are given in Tables 1 and 2. The calibration standards covered in Table 1 are commonly used for aneroid barometers and surveying altimeters; in Table 2 are given the United States, British, and the ICAN calibration standards for aviation altimeters.

Comparison of standard atmospheres.—It will be seen that the standard atmospheres differ mainly (*a*) in the altitude-temperature assumption, and to a minor extent (*b*) in the standard value of the acceleration

Table 1.—Altitude-Pressure Tables Used in Calibrating Aneroid Barometers

Altitude	Pressure in inches of mercury				
	Airy's Scale	S.M.T. Table 51	U.S. altimeter before 1926	Paulin (Swedish)	German
Feet	*10°C.*	*10°C.*	*10°C.*	*10°C.*	$T=f(z)$
−1,000	—	31.021	31.02	—	—
− 500	—	30.455	30.45	—	—
0	31.000	29.900	29.90	30.00	30.00
500	—	29.355	—	—	—
1,000	29.883	28.820	28.83	28.92	28.91
1,500	—	28.295	—	—	—
2,000	28.807	27.820	27.79	27.88	27.86
2,500	—	27.272	—	—	—
3,000	27.769	26.775	26.79	26.88	26.84
3,500	—	26.287	—	—	—
4,000	26.769	25.808	25.83	25.91	25.85
4,500	—	25.338	—	—	—
5,000	25.804	24.875	24.90	24.97	24.90
6,000	24.875	23.977	24.00	24.08	23.97
7,000	23.979	23.110	23.14	23.21	23.08
8,000	23.115	22.276	22.31	22.37	22.21
9,000	22.282	21.472	21.51	21.57	21.37
10,000	21.479	20.696	20.73	20.79	20.56
11,000	20.706	19.948	19.99	20.04	19.77
12,000	19.959	19.228	19.27	19.32	19.01
13,000	19.240	18.533	18.58	18.65	18.27
14,000	18.548	17.864	17.91	17.96	17.56
15,000	17.880	17.218	17.27	17.31	16.88
16,000	17.235	16.596	16.65	16.69	16.21
17,000	16.615	15.997	16.05	16.08	15.57
18,000	16.016	15.419	15.47	15.51	14.95
19,000	15.439	14.862	14.91	14.95	14.35
20,000	14.883	14.325	14.38	14.41	—
21,000	14.347	13.808	13.86	—	—
22,000	13.830	13.309	13.36	—	—
23,000	13.332	12.828	12.88	—	—
24,000	—	12.365	12.42	—	—
25,000	—	—	11.98	—	—
30,000	—	—	9.97	—	—
35,000	—	—	8.30	—	—
40,000	—	—	6.91	—	—

of gravity, and (*c*) in the physical constants entering into the constant term of the altitude equation even when reduction is made to a common basis of ground level pressure and temperature. In most cases the values of altitude obtained will not differ significantly if the appropriate values of the temperature, gravity, and humidity corrections are applied.

The values of the physical constants embodied in the constant term in the Smithsonian, U. S. Aeronautic, and ICAN standard atmospheres are equivalent and are believed accurate.

It will be noted that the values of standard gravity differ somewhat for the various standard atmospheres. In particular, the International Standard (980.665 cm/sec^2) is used in the United States, while European countries use the above value adjusted to give the value assumed to be that at latitude 45° (980.62 cm/sec^2). The value of gravity used affects the constant term (or exponent of ICAN) of the formula; the difference is 1:22000 in the altitudes corre-

Table 2.—Standard Altitude-Pressure Tables Used in Calibrating Aviation Altimeters

Pressure altitude 1,000 feet	United States			British		ICAN
	Mm of mercury	Inches of mercury	mb	Mm of mercury	mb	Mm of mercury
−1	787.9	31.02	1050.4	—	—	—
0	760.0	29.921	1013.3	760.0	1013.2	760.0
1	732.9	28.86	977.1	732.9	977.1	—
2	706.6	27.82	942.1	706.6	942.1	—
3	681.1	26.81	908.1	681.1	908.1	—
4	656.3	25.84	875.0	656.4	875.1	—
5	632.3	24.89	843.0	632.3	843.0	632.3
6	609.0	23.98	811.9	609.1	812.0	—
7	586.4	23.09	781.8	586.4	781.8	—
8	564.4	22.22	752.5	564.5	752.6	—
9	543.2	21.38	724.2	543.3	724.3	—
10	522.6	20.58	696.7	522.6	696.8	522.6
11	502.6	19.79	670.1	502.7	670.2	—
12	483.3	19.03	644.3	483.3	644.4	—
13	464.5	18.29	619.3	464.6	619.4	—
14	446.4	17.57	595.1	446.4	595.2	—
15	428.8	16.88	571.7	428.9	571.8	428.8
16	411.8	16.21	549.0	411.9	549.1	—
17	395.3	15.56	527.0	395.4	527.2	—
18	379.4	14.94	505.8	379.9	506.0	—
19	364.0	14.33	485.3	364.2	485.5	—
20	349.1	13.75	465.4	349.2	465.6	349.1
21	334.7	13.18	446.2	334.8	446.4	—
22	320.8	12.63	427.7	321.0	427.9	—
23	307.4	12.10	409.8	307.5	410.0	—
24	294.4	11.59	392.5	294.5	392.7	—
25	281.9	11.10	375.8	282.0	376.0	281.9
26	269.8	10.62	359.7	269.9	359.9	—
27	258.1	10.16	344.1	258.2	344.3	—
28	246.9	9.720	329.2	247.0	329.3	—
29	236.0	9.293	314.6	236.2	314.9	—
30	225.6	8.880	300.8	225.7	300.9	225.6
35	178.7	7.036	238.2	178.8	238.4	178.7
40	140.7	5.541	187.6	140.7	187.6	140.5
45	110.8	4.364	147.7	110.6	147.5	110.5
50	87.30	3.436	116.4	87.00	116.0	86.9

sponding to a given pressure, ordinarily negligible.

In these countries also the respective values of standard gravity are used to define the inch or millimeter of mercury. Thus the values of pressure in the United States are for millimeters or inches of mercury at a gravity of 980.665 cm/sec^2, and for the other countries at 980.62 cm/sec^2; to convert to pressures based on 980.665 cm/sec^2 the pressures based on 980.62 cm/sec^2 must all be reduced in the ratio 1:22000, equivalent to an altitude difference of about 1.3 feet, independent of altitude. This difference is usually negligible.

In comparing altimeters calibrated to the ICAN standard atmosphere, or modified ICAN, this difference in standard gravity must be considered in its effect both on the standard atmosphere and on the standard of pressure. The difference in the gravity used in the United States and European standard atmosphere causes a difference in the indicated altitude of one part in 22,000, as has been said. The difference in the standard of pressure causes a constant difference in indication of about 1.3 feet; when the pressure scales of a U. S. and a British altimeter are both set to read 760 mm of mercury or its equivalent, the British altimeter will read 1.3 feet lower. Other differences in the standard atmospheres and the variation of altimeter readings at a given pressure make the differences in this respect insignificant.

The pressure in millibars given for the British Aeronautic standard in Table 2 is taken from a British publication (*10*); the conversion to millimeters of mercury is made based on a gravity of 980.665 cm/sec^2 in order to obtain a direct comparison with U. S. Aeronautic standard.

Determining altitude with altimeters.—As has been stated, when pressure observations, not altitude, are made, the altitude is determined by computation, using barometric formula (1) or (3).

When an altimeter is used, thus securing readings in altitude units, the general relation to be used in computing altitudes is obtained by substituting for log $P_1 - \log P_2$ in formula (1) its value obtained from the formula defining the standard atmosphere, as for example formula (10) or (18). There is obtained:

$$H = Z\frac{T_m}{T_{ms}}\left[1 + 0.376\left(\frac{e}{p}\right)_m\right]\cdot\left[1 + \frac{g_s - g_m}{g_s}\right], \quad (25)$$

where H is the altitude between any two pressure levels P_1 and P_2; Z is the corresponding altitude in the standard atmosphere; T_m is the mean temperature of the air column; and T_{ms} is the mean temperature of the air column in the standard atmosphere used to calibrate the altimeter.

Formula (25) is of general application. If the humidity and gravity terms are neglected, formula (25) becomes

$$H = Z\frac{T_m}{T_{ms}}\cdot \quad (26)$$

The use of formula (25) or (26) carries the implication that Z is measured with reference to the lower pressure level P_1; the altimeter reading must be corrected to obtain this value of Z or the altimeter adjusted so that it reads zero at pressure P_1.

(*a*) *Isothermal standard atmosphere.*—It is evident that computation of altitude is simplified for standard atmospheres in which T_{ms} is a constant. For this reason most standard atmospheres used in calibrating surveying altimeters are isothermal; in most such atmospheres the mean temperature is 10°C. = 50°F. = 283 °K. For ease in computation, formula (26) can be written

$$H = Z\left(1 + \frac{T_m - T_{ms}}{T_{ms}}\right) \quad (27)$$

where

$$\frac{T_m - T_{ms}}{T_{ms}}Z$$

is defined as the temperature correction. Tables of the temperature correction, T_m against Z, such as given in the SMT, can be easily computed and used; nomograms are available for use in calculating H when Z and T_{ms} are known.

(*b*) *Aeronautic standard atmosphere.*—If the mean temperature T_{ms} of the standard atmosphere to which the altimeter is calibrated varies, the computation of the temperature correction is more complicated. In the case of the aeronautic standard atmos-

pheres the temperature is assumed to fall linearly with pressure altitude in order to obtain indicated altitudes more nearly in agreement with average atmospheric conditions. Consider only the aviation altimeter calibration standard used in this country; all that will be said will apply equally well to the ICAN standard, or its modifications.

Formula (18c), modified to determine T_{ms} between P_1 and P_2, becomes

$$T_{ms} = \frac{aZ}{\ln \dfrac{288 - aZ_1}{288 - aZ_1 - aZ}} \qquad (28)$$

$$= 288 - aZ_1 - \frac{aZ}{2} \text{ approx.} \qquad (28a)$$

Further, define $288 - aZ/2 = T_{mz}$, whereupon formula (28a) becomes

$$T_{ms} = T_{mz} - aZ_1 \text{ approx.} \qquad (29)$$

where Z_1 = pressure altitude of lower level
Z = altitude between pressure levels P_1 and P_2
a = temperature lapse rate, 0.0019812°C./foot
T_{ms} = standard mean temperature of air column P_1 to P_2
T_{mz} = standard mean temperature corresponding to a pressure altitude equal to Z, easily obtained from available tables.

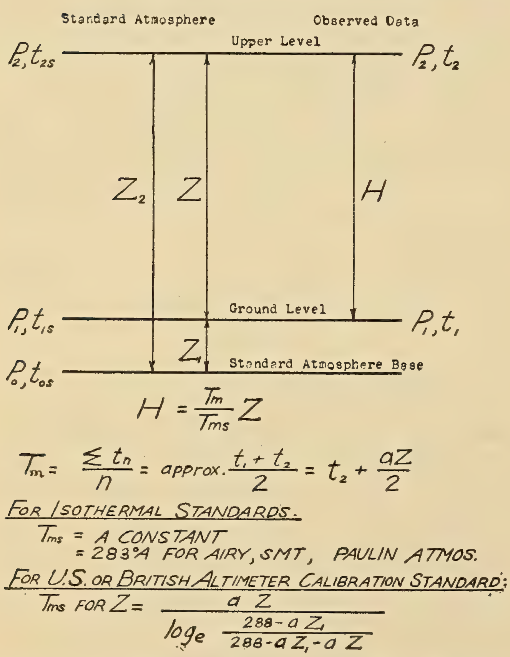

Fig. 3.—Illustrates definitions of terms used in an altitude determination by altimeter.

These definitions are illustrated in Fig. 3.

Formula (28a) or (29) is an approximation with negligible error for values of Z_1 up to 5,000 feet. The error can be found in any individual case by comparing values of T_{ms} computed by formulas (28) and (29).

Thus for aviation altimeters,

$$H = Z \frac{T_m}{T_{ms}} = Z \frac{T_m}{T_{mz} - aZ_1}. \qquad (30)$$

Examples of altitude determination in surveying.—In the following discussion it is assumed that the instruments used are free from error.

(A) Accurate elevations of a number of stations in rolling country are to be obtained. It is assumed that there is at least one base in the area or that two bases flank the area, the elevations of which are known; and further, that the time between observations is reasonably short, say, of the order of thirty minutes.

The observations required are as follows:

(a) A record must be obtained of air pressure against time at the base or bases. This can be secured most conveniently by a barograph, preferably a microbarograph in order to secure adequate sensitivity.

(b) An altimeter, preferably graduated to the altitude-pressure relation of an isothermal atmosphere, is read at the base and at the various selected stations, and recorded, together with the time of observation. It is an advantage from the viewpoint of correcting for drift of the altimeter to repeat the readings in reverse order at each of the points. More consistent results are obtained if the reading is made about 5 to 10 minutes after arriving at the station, particularly if the change in elevation between two stations is relatively great.

(c) The air temperature at the base or bases and at each station should be measured at the time of making the pressure observation at each station. A continuous record of the air temperature against time is a desirable means for obtaining the required temperatures at the bases. The ex-

posure of the thermometers must be such as to avoid the direct rays of the sun. The thermometer should be at least 3 or 4 feet above the ground in an effort to measure the true free air temperature. The time of exposure at the station must be sufficient to eliminate the time lag of the particular thermometer used.

(*d*) If the humidity correction is to be applied, the humidity must in general be measured simultaneously with the air pressure under (*b*). If the weather does not change, the water vapor pressure, which is the quantity required, may remain nearly constant from station to station, although the relative humidity will change with temperature.

(*e*) The data for making the gravity correction, if desired, are obtained from published data as previously discussed.

The data in (*a*) are used to secure the value of the base pressure P, or its equivalent the altitude in the standard atmosphere, at the time of making each station observation. This insures simultaneity, but still leaves open the question of verticality of the observations. If observations at two or more bases are available, the base pressure or altitude directly below (or above) the station is secured by interpolation. If there is only one base station, the effect of change in barometric pressure with distance from the base can be determined from a weather map, or pressure data from a nearby Weather Bureau station, or failing these, some estimate can be made from the barograph record at the base.

From data (*a*) and (*b*) the altitude in the standard atmosphere at each station is obtained by simple computation, that is $Z=Z_1-Z_0$, where Z_0 and Z_1 are the altitudes of the base and station respectively.

The mean temperature T_m of the air column may be taken as the mean of the two air temperatures at the base and the station if Z is small, say under 500 feet. In some cases T_m can be taken as the air temperature at the station with little loss in accuracy.

With these data the altitude above the reference base is calculated by formula (26). Further refinement would include humidity measurements to determine the humidity correction (formula 7 or 25) and evaluation of the gravity correction (formula 8 or 25). Then the elevation of the station above sea level is $H+h$, where h is the elevation of the base. With ordinary care an accuracy of 1 percent or about 20 feet, whichever is greater, can be secured.

(*B*) The second example concerns the case where a mountain climb is made and the height of the mountain to the best accuracy is desired. It differs from case (*A*) in that the climb usually requires a relatively long time, extending over one or more days, and in that the base or the point of known elevation is often far from the mountain peak.

As in case (*A*), a pressure and temperature record against time is desirably obtained at a point of known elevation or base.

An altimeter or aneroid barometer, a thermometer, and perhaps a psychrometer should be read at various points during the climb and, of course, at the peak.

The chief difficulty in the computation of the altitude is the adjustment of the temperature data to obtain simultaneity, since the readings at the various elevations during the climb are taken with considerable time interval between them; no hard and fast rules can be laid down, and some uncertainty is inevitable.

No serious error due to failure to obtain simultaneity in the pressure observations made during the climb for use in computing mean temperature will be present if a pressure record is obtained at a base. However, the variation due to distance between the base and the mountain stations or verticality of observations, often requires consideration. In the absence of line squalls and thunder storms, and if the distances between climber and base are not too great, errors due to neglect of verticality corrections in the intermediate pressures used to compute the mean temperature will not introduce serious errors. However, the pressure or altitude reading at the point at which the altitude is to be determined should be corrected for the space factor, if possible, or the correction at least be proved negligible.

Calculations of the humidity and gravity

corrections offer no difficulty since the observed or derived data are not needed to high accuracy and therefore the refinements of applying corrections to obtain simultaneity and verticality can be omitted. The chief difficulty is in making the humidity measurements and, in some cases, in obtaining gravity data.

(*C*) Many exploration trips in unsettled mountainous country are made in which observations of an aneroid barometer or altimeter are the sole reliance for determining altitude. In the extreme case there is no base of known elevation which can be visited except perhaps at the start and finish of the trip. Errors in altitude determination are likely to be quite large owing to variations in the base pressure, which must be implicitly or explicitly assumed, and to a lesser degree owing to the lack of knowledge of the mean temperature. It is best in these cases to use an aneroid barometer which measures the atmospheric pressure, or an altimeter set to read pressure altitude, that is, altitude above the base pressure assumed in the altimeter calibration standard.

Errors due to lack of a base pressure can be reduced somewhat when it is possible to spend a long time at the station. In this case the altimeter or aneroid barometer is read three or four times daily at the same hours as widely spaced as possible. The altitude is then the average of the altitude readings or the average of the pressures converted to altitude in the standard atmosphere, preferably isothermal. This procedure still leaves uncertainty since it assumes a sea level pressure of 760 mm of mercury, while the average sea level pressure at a given station may differ considerably from this value.

In general, altitudes determined by the above procedure give altitudes in winter which are much too low; in summer also too low, but much less so than in winter. Detailed meteorological studies of a given region are required to determine empirical methods of making corrections.

(*D*) A case of general interest is that where altitude observations are made only with an altimeter or aneroid barometer, but readings are secured occasionally at points of known elevation. Here the altitudes of subsequent points of interest are obtained from readings of the instrument, corrected either by adjustment of the instrument to read the altitude of the bases as encountered or by computation to tie in with the points of known elevation. The error due to time from the base will usually not exceed about 50 feet per hour and that due to distance, usually not more than about 50 feet per 10 miles of distance.

The failure to correct for mean temperature of the air column introduces much less error than the above uncertainties, especially when the elevation of the base is a good fraction of the elevation of the point of interest, since the correction is applied only to the observed altitude above or below the base. In general, failure to correct for air temperature error introduces approximately a 1 percent error in the altitude above the base, for every 3°C. deviation in actual mean temperature from the value in the standard atmosphere.

Altitude of aircraft.—When it is remembered that the aneroid altimeter indicates only the altitude between two pressure levels, it is obvious that the altitude of an aircraft above ground level can be determined only in special cases. The changing elevation of the ground below and inability in general to obtain ground level pressure preclude obtaining precise altitude data at all times during flight. Other means than the aneroid altimeter must be used.

However, on airways the ground level pressures at the nearest airport are furnished at close time intervals and knowledge of the airway topography makes it unnecessary in most cases to have more than the altimeter indication For landing, precise indications of altitude above the field can be obtained as discussed later.

The altimeter is particularly useful in flying at a desired pressure level as indicated in terms of pressure altitude, or as is more general, in standard altitude above sea level, approximately. In the latter case the pressure scale of the altimeter is set to the pressure corresponding to the pressure altitude of a nearby airport minus the elevation of the airport above sea level.

There are four cases of particular interest which will be discussed in some detail be-

low. As before, the instrumental corrections will be assumed applied.

A. Airplane flights for an altitude record are made within a few hours usually with take-off and landing from the same airport. Balloon flights take longer and the landing point is usually distant from the take-off point. These flights are all made under the regulations of the Fédération Aéronautique International (*14*). The data obtained are (*a*) pressure and air temperature at the ground level during the flight, (*b*) free air pressure continuously recorded in the aircraft, and (*c*) free air temperature with the corresponding air pressure recorded in the aircraft at short time intervals.

From these data the mean temperature can be computed by the first method described in the section on "Computation of Mean Temperature." It may be necessary to correct the observed values of temperature at the lower levels to obtain observations synchronized with those obtained at the highest altitude.

The altitude is determined officially by a step method, formula 3a, or alternatively by the relation

$$H = 18400 \frac{T_m}{273} L \log \frac{P_0}{P} + A + h, \qquad (31)$$

where H = the altitude above sea level in meters.

T_m = the mean temperature in °K

P_0, P = simultaneous values of the pressure at the ground and at the highest altitude, respectively

L = factor, correcting in terms of latitude for deviation from standard gravity, here 980.62 cm/sec².

A = correction term for variation of gravity with altitude and to adjust for the assumption of a relative humidity of 60 percent. It varies with altitude.

h = altitude above sea level of airport, in meters.

B. The second case, on determining altitude just before landing, is important in ordinary aircraft operation. The problem is to obtain altitude indications sufficiently reliable for use in making a landing. Since the temperature error is zero at zero altitude and indicated altitudes above the airport are sufficiently accurate to clear obstacles at most airports, correction for air temperature error is unnecessary. Thus the problem resolves itself only to that of properly resetting the zero of the altimeter.

Two methods of resetting just before landing are used. In the method usually preferred on airlines, approximate altitude above sea level is indicated because of its advantages in flying over mountainous country. The pressure scale of the altimeter is reset in flight, so that the altimeter will read upon landing the elevation above sea level of the airport. This pressure is officially called the "altimeter setting" and in the early days of its use "the Kollsman Number." This pressure can be obtained at the airport by reading the pressure scale of an altimeter when it is set so that the pointers indicate its elevation above sea level. If only the air pressure is measured at the airport, the "altimeter setting" is determined as follows: Convert the air pressure to pressure altitude, subtract the elevation above sea level of the barometer from the pressure altitude, and finally convert the last obtained altitude to pressure in the standard atmosphere. The "altimeter setting" can also be obtained directly from an aneroid instrument called an altimeter setting indicator, to be described later.

The second method of setting the altimeter in flight is such that the altimeter reads zero upon landing. In this case the pressure scale is reset simply to the ground level pressure received by radio from the airport. This is the reading of the pressure scale of an altimeter set to read zero altitude at the runway level of the airport.

C. For some purposes it is desired to determine the aircraft altitude when above a point of known elevation. The uncertainties in a determination are ordinarily such that consideration of correction factors other than ground level pressure or air temperature error is of no significance.

If there is communication with the ground, the altimeter can be set to ground level pressure as indicated in the second method of section B just above; if there is no such contact, the pressure to which to

set the altimeter offers difficulties. It may be preset using a prediction based on a weather map obtained before flight, or by flying low just before the altitude is needed, estimating the altitude, and resetting the altimeter to indicate this altitude. The latter procedure is, of course, not practical if there is ground fog.

In practice, it is not always possible to obtain sufficient data to compute accurately the mean temperature; in fact, only one reading is often available, the free air temperature at the flight level. In the latter case formula (5) is used to compute the mean temperature. The altitude is then computed using formula (26). Computers (*15*) (*16*) are available for computing the altitude based on formula (26) entering either with the mean temperature or with the flight level air temperature.

D. In the last case to be considered flight is to be maintained for some time at a fixed and constant altitude above a base. In this case it is preferable to use an altimeter rather than an aneroid barometer, and one calibrated to an isothermal atmosphere, if there is any choice. The indication of the altimeter to be maintained in flight corresponding to the desired altitude is to be determined.

First, the pressure scale of the altimeter must be kept continuously set to the ground level pressure at the base. Altitudes in the standard atmosphere above the base are then indicated.

The altimeter reading Z corrected for air temperature for the desired altitude H is

$$Z = \frac{T_{ms}}{T_m} H = \left(1 + \frac{T_{ms} - T_m}{T_m}\right) H. \qquad (26)$$

The value of Z can be obtained from a curve or a table based on formula (26).

If the mean temperature T_{ms} in the standard atmosphere is a constant, the computation is quite simple. For example, if $T_{ms} = 283°$K, the readings to maintain 10,000 feet true are given in Table 3.

If T_{ms} is not constant, the table becomes more complicated, since T_{ms} varies with the ground level air pressure. For example, if an altimeter calibrated to the U. S. standard atmosphere is used, it can be shown that

TABLE 3.—ALTIMETER READING TO MAINTAIN 10,000 FEET

Mean Temperature	Altimeter Reading, Z
T_m °C.	Feet
20	9,659
10	10,000
0	10,366
−10	10,760
−20	11,186

T_{ms} is to a close approximation:

$$T_{ms} = T_{mz} + \frac{a(T_m - T_{mz})H}{2T_m} - aZ_0 \qquad (32)$$

where T_{mz} = mean temperature in °K obtained by entering tables of mean temperature against pressure altitude with the altitude H

a = temperature lapse rate, 1.98°C per 1,000 feet

Z_0 = pressure altitude at ground level.

The standard mean temperatures for a true altitude of 10,000 feet for various actual mean temperatures, computed by formula (32), are given as an example in Table 4.

TABLE 4.—MEAN TEMPERATURES IN U. S. STANDARD ATMOSPHERE AT 10,000 FEET

Mean Temperature, T_m	Mean temperatures in U. S. standard atmosphere at 10,000 feet true altitude Ground level pressure, inches of mercury				
°C.	29.00	29.50	30.00	30.50	31.00
20	+3.9	+4.8	+5.7	+6.7	+7.6
10	+3.5	+4.4	+5.3	+6.3	+7.2
0	+3.1	+4.0	+4.9	+5.9	+6.8
−10	+2.7	+3.6	+4.5	+5.5	+6.4
−20	+2.3	+3.2	+4.1	+5.1	+6.0

The altimeter readings to maintain 10,000 feet, using the standard mean temperatures in Table 4 and formula (26) are given in Table 5.

TABLE 5.—ALTIMETER READING TO MAINTAIN 10,000 FEET

Mean Tempera- T_m	Altimeter reading, feet Ground level pressure, inches of mercury				
°C.	29.00	29.50	30.00	30.50	31.00
20	9,450	9,481	9,513	9,546	9,577
10	9,779	9,802	9,834	9,869	9,901
0	10,113	10,141	10,179	10,216	10,249
−10	10,483	10,517	10,551	10,590	10,624
−20	10,890	10,919	10,954	11,000	11,028

Similar tables, or curves, can be prepared for other desired altitudes.

If gravity or humidity corrections are to be applied, use formulas 7, 8, and 9 and apply the corrections with the opposite sign to the readings of Z given in Table 5 or similar tables.

ANEROID BAROMETERS AND ALTIMETERS

This section will be limited to a brief description and a discussion of the performance of aneroid instruments. Thermometers will not be discussed, since data on the common mercury type ordinarily used in surveying are readily available. See references (*4*) and (*17*) for data on electrical types suitable for aircraft use.

Aneroid barometers and altimeters for convenience may be divided into groups according to function:

(*a*) Aneroid barometers for measuring atmospheric pressure.
(*b*) Surveying altimeters and barometers for determining the elevation of terrestrial points.
(*c*) Aviation altimeters.
(*d*) Altimeter setting indicators.
(*e*) Barographs for recording ambient atmospheric pressure.
(*f*) Aviation barographs.

The development of the aneroid barometer for measuring atmospheric pressure and for use in surveying into an instrument of high precision and reliability has been greatly retarded by the small market for such instruments. Competitive development that accelerates progress has not been stimulated by the available market. However, since the aviation altimeter and the aneroid barometer in their essentials differ very little, the greater emphasis placed on research and development of aviation altimeters has been of immediate benefit in improving aneroid barometers.

The chief aims in development have been (*a*) to increase the sensitivity of indication and coupled with this, (*b*) to make the reliability and accuracy commensurate with the sensitivity. The necessity of portability, since that is the chief virtue of the aneroid barometer in comparison with the mercurial barometer, has focused attention upon methods of protecting the mechanism from shocks normal to transportation.

(*a*) *Aneroid barometers.*—A variety of aneroid barometer mechanisms have been designed and constructed in recent years in efforts to improve over-all performance in the ranges required for measuring atmospheric pressure at weather stations. Among these may be mentioned the Paulin, Friez, Kollsman, and the Wallace and Tiernan. The dial diameter of these instruments

Fig. 4.—Aneroid barometer, range 610 to 1,085 millibars. Pointer makes two revolutions; scale $7\frac{1}{4}$ inches in diameter. The humidity and correction factor is obtained from the nomogram at the top of the cover; the conversion of pressure to altitude in the SMT standard atmosphere is given in the chart in the middle; and data on the temperature error of the barometer can be plotted on the graph at the bottom.

varies from 5 to 9 inches. The pointer may rotate from 270° to several revolutions in the various designs.

In the most open scale of these instruments, the scale length is about 7 inches for each inch of mercury, so that readings to the nearest 0.1 mb or millimeter are easily made. The reliability over a period of

months when in the laboratory appears to be about equal to the sensitivity above given.

(*b*) *Surveying altimeters and barometers.*—Except for an extension in range, and in some cases calibration to a standard atmosphere, usually isothermal, the instruments commercially available are the same as the aneroid barometers discussed under (*a*). At present precision instruments of this type appear to be produced in this country only

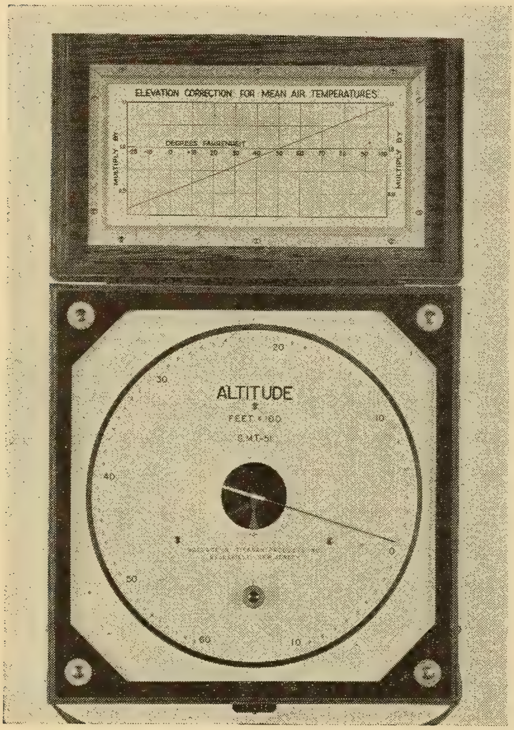

Fig. 5.—Surveying altimeter, $-1{,}000$ to 6,000 feet, calibrated to SMT standard atmosphere. Secale, $7\frac{1}{2}$ inches in diameter. Note the chart for determining the temperature correction.

by Wallace and Tiernan (*18*), although the precision Short and Mason and the Paulin instruments also available in this country should be mentioned.

Fig. 4 shows an aneroid barometer for use in surveying in which the chart is used for converting the pressure to standard altitude and for obtaining a factor based on observed air temperatures and relative humidity for use in making a correction for deviation of these quantities from the standard values.

A surveying altimeter is shown in Fig. 5 together with a nomogram for computing the temperature correction when the needed air temperature data are available. The scale, $7\frac{1}{2}$ inches in diameter, covers a range of 7,000 feet in nearly one revolution. It can be read to about the nearest two feet.

Surveying barometers are often equipped with an altitude scale, rotatable with reference to the fixed dial graduated in pressure units. This enables altitude readings to be made in terms of approximate standard altitude above the pressure level of the base.

It should be mentioned that the standard size aviation sensitive altimeter can be read to the nearest one or two feet, but owing to the friction in its mechanism, the reading can not be relied upon closer than about 10 to 20 feet. It is, therefore, not used if more accurate data are required.

However, sensitive altimeters in the 6-inch dial size have been built in which the friction is but slightly greater than that of the surveying instruments above mentioned. These have been used in surveying, although not ideally suited for the work, since none are available calibrated to an isothermal standard atmosphere.

(*c*) *Aviation altimeters.*—A dial view is shown in Fig. 6 of the standard aircraft sensitive altimeter. The major divisions on the dial, 1, 2, etc., have three values: 100 feet for the largest pointer, 1,000 feet for the intermediate pointer, and 10,000 feet for the smallest pointer. The zero adjustment, which has been previously discussed but not described, is made by the thumb knob at the lower left of the instrument. Operation of this knob rotates the inset pressure dial, graduated in inches of mercury, to any desired value in its range; at the same time the pointers are also reset by a corresponding amount. For example, if the pressure setting is reset to 30.00, the pointers are at the same time reset from the reading shown, 411 feet to 484 feet. If the altimeter is now subjected to a pressure of 30.00 inches of mercury, it will read 0 feet. As shown in the figure, the altimeter will read 0 feet at 29.92 inches of mercury, and -73 feet at 30.00 inches of mercury.

On the other hand, if the altimeter is reset to read zero, the pressure indication should

be the ambient atmospheric pressure, or 29.48 inches of mercury, corresponding to the pressure altitude of 411 feet.

For additional details on design and operation see reference (*19*).

(*d*) *Altimeter setting indicators.*—These instruments, described by Colvin (*20*), are essentially altimeters, that is, with a pointer motion directly proportional to altitude, but with a scale graduated in terms of "altimeter setting" commonly 31 to 28 inches of mercury. Their function is to indicate the altimeter setting directly, without the necessity of making the computations necessary when pressure readings are made. The accuracy required is better than can be secured with an aircraft altimeter of the standard sensitive type. Colvin as a result of preliminary tests, shows that the over-all errors should not exceed about 0.01 inch of mercury.

(*e*) *Barographs* for measuring atmospheric pressure will not be discussed except to point out that seasoned microbarographs may be preferable to an aneroid barometer for measuring air pressures at a base, if an over-all accuracy and sensitivity of reading of 0.01 inch of mercury or less is required. Microbarographs commonly available (Friez or Taylor) have a pen motion of 2.5 inches per inch of mercury.

(*f*) *Aviation barographs* commonly used are of the "double traverse" type, that is, the pen makes two traverses of the chart for the range. This instrument is described by Peterson (*21*).

Performance of aneroid barometers and altimeters.—The factors affecting the performance of aneroid intruments are (*a*) hysteresis, (*b*) drift, (*c*) scale errors, (*d*) temperature errors, (*e*) zero shift, (*f*) vibration and friction, and (*g*) shock resistance.

In the discussion that follows, a "rested" instruments is one which has for all practical purposes been subjected to no pressure change in the previous 24 or more hours. An instrument is put into the "cyclic" state by seasoning or subjecting it to a number (not less than about 5) of cycles of pressure change, the range of which defines the pressures for which the cyclic state exists.

All aneroid pressure measuring instruments are subject to errors due to the departure from perfect elastic behavior which is common to all stressed metals. These errors depend on the entire past history of the instrument in a complicated fashion but may be divided roughly as follows: hysteresis, which depends on the direction and magnitude of the last significant stress change, but shows little or no time dependence; recoverable drift, which depends on the stress change and time; and zero shift or irrecoverable drift, which may continue over a long period of time. In general

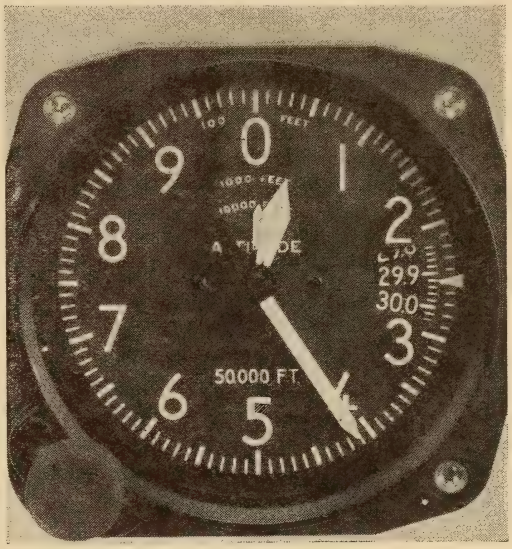

Fig. 6.—Aviation altimeter. Operating the thumb knob at the lower left resets the pressure scale and correspondingly the pointers. Dial size, $2\frac{3}{4}$ inches.

the pressure sensitive element contributes by far the most to these elastic phenomena, but all stressed parts are involved to some extent. The friction and other imperfections of the mechanism may contribute to the hysteresis and in many designs may mask it by the uncertainty produced in the readings.

Hysteresis is the difference in reading at a given pressure for pressures decreasing and increasing when the instrument is subject to a pressure cycle. In general the change in reading in each half of the cycle tends to lag behind the pressure. Thus an altimeter reads higher at a given pressure in the altitude-decreasing (pressure-increas-

ing) than in the altitude-increasing part of the cycle.

The hysteresis is in general a maximum at approximately the middle of the pressure range of the cycle.

The hysteresis at ambient atmospheric pressure, that is, at zero altitude at which the pressure cycle usually is started, is sometimes referred to as the after effect. The recovery or the return to the initial reading obtaining before the pressure cycle requires 24 hours or more.

If the instrument is in the cyclic state in subsequent cycles made within an hour or so afterwards, the hysteresis is reduced to about 50 per cent in amount and the after effect to about 25 per cent or less. The hysteresis for the cyclic state is largely the component independent of time. The other component, which is a time phenomena, is recoverable drift, as discussed later.

The hysteresis is affected somewhat by the speed of making the pressure cycle, but in most circumstances not significantly.

In the best altimeters and aneroid barometers now available the hysteresis of a rested instrument, when subjected to a pressure cycle in which the pressure altitude is changed approximately uniformly at a rate between 200 to 500 feet per minute, is about as follows:

	Altitude and pressure range of cycle			
	0–2,000	0–10,000	0–15,000	0–35,000 feet
	760–700	760–500	760–400	760–200 mm Hg
Maximum hysteresis:				
in feet....	5–10	10–20	20–35	40–70
in per cent pressure change..	—	0.10–.20	.15–.25	.15–.25
Initial after effect, feet.	2–5	7–15	—	40–60

In cycles of small pressure range, the uncertainty in reading is more likely to be of greater magnitude than the hysteresis.

Drift is the slow and usually small change in reading with time subsequent to any and every pressure change. To illustrate, if an aneroid barometer or altimeter be suddenly subjected to a pressure change, the reading will change an amount approximating the pressure change within a few seconds and then will continue to increase slowly for hours in the direction of the pressure change. The rate of drift is greatest initially and decreases quite rapidly with time. If the sensitivity of the instrument is sufficient the increases in reading may be detectable for a time interval after the pressure change up to 24 hours or more.

Drift occurs in all instruments, the sensitive element of which is an elastic system, as for example, a spring or a diaphragm capsule.

The observed drift is the resultant of the effect of all pressure changes that have been imposed upon the instrument up to at least 24 hours previously; the magnitude of the contribution is greatest for larger pressure changes and for pressure changes imposed most recently. In other words, the reading of the instrument depends upon the history of the pressure changes to which it has been subjected. It is therefore impractical to apply corrections for drift except perhaps for the simplest conditions of use.

The relatively small amount of dependable data available indicates that in good quality aneroid instruments originally in the rested state, the drift in one hour, observed after a sudden change in pressure with the initial reading obtained in about one minute after completing the pressure change, is of the order of 0.15 percent of the pressure change; if the rate of pressure change is equivalent to about 1,000 feet per minute the drift reduces to about 0.10 percent. The rate of drift is most rapid initially; about one-half of the drift occurs in the first 30 minutes. For examples of drift curves see reference (*19*).

The initial after effect, after completing a pressure cycle made as rapidly as possible except for a 2-hour drift period at the lowest pressure, for good quality altimeters originally in the rested state, varies from about 0.2 to 0.3 percent of the pressure change. The amount is somewhat less if there is no drift period; for values see the section on hysteresis. The initial after effect in general is somewhat less, if the pressure cycle is made relatively slowly, particularly in the part of the cycle near the initial pressure. In this case some of the recovery has had time to take place before reaching the initial pressure.

Drift is of particular importance in determining the altitude of aircraft in landing.

Subsequent to the landing the drift continues for a time interval up to 24 hours or more, independent of the length of time at altitude. This drift at the end of a pressure cycle is often called "recovery"; the amount by which the altimeter fails to indicate upon landing the reading before the flight at the same pressure is called the "after effect." The altimeter reading upon landing is always higher than the reading at take-off, making due allowance for the difference in the take-off and landing pressures. The recovery becomes larger with time, the after effect, smaller.

If the instrument is in the cyclic state for a given pressure range, the observed after effect just at the completion of the pressure cycle will be much reduced. In this case readings are being compared which are both unstable with time; recovery to the "rested" condition is taking place with time when the instrument is in the cyclic state.

Scale error, sometimes called calibration error, is the error in the indication of the instrument, usually determined when the instrument is at a specified temperature in the range 20 to 25°C. It is a measure of the accuracy to which the correspondence of dial to mechanism performance has been achieved. In most designs adjustments are provided in the mechanism to obtain this correspondence within close limits. The scale error, E, is related to the reading R and true value T by the relation $R=T+E$; thus a plus error means that the instrument reads too high, a minus error, too low.

It is often more convenient to have the corrections to be applied to the readings. In this case the correction C is defined as follows: $T=R+C$.

In many cases the scale error is the only error for which it is practical to apply correction to instrument readings. This is particularly true of aneroid barometers and altimeters. If corrections will be applied, the amount of the scale error is not important, although it is distinctly advantageous that it be as small as possible. The scale errors of an altimeter, unless otherwise specified, are for the case when the pressure scale is set to the value at zero feet, so that the altimeter should indicate pressure altitude in the particular standard atmosphere to which it is calibrated. For other pressure settings the scale error at a given indication may be expected to differ.

Because of drift, the scale error of precision instruments is affected significantly by the average rate at which the pressure is changed during the course of a test. The practice in testing is to change the pressure to which instruments are subjected by steps; at each step the instrument and the standard are read. The average rate of pressure change is governed largely by the time at each pressure step. For altimeters the reading is made in from about 2 to 10 minutes after the pressure change has been made without obtaining significant differences in scale error. For barometers and altimeters not used in aircraft it is usually desirable that the reading be made as long a time as possible after completing a pressure change in order to obtain corrections under conditions most closely simulating service conditions; twenty minutes between test points seems a practical limit in routine testing.

For general use, where the direction and rate of the pressure changes can not be definitely specified, it is best to take as the scale error at a given reading, the average of the error for pressures decreasing and increasing obtained in a pressure cycle. Whenever the conditions of use can be simply specified as in case of readings made during steady continuous ascent of an airplane, the corrections for the errors under these conditions should be applied. However, even the slightest reversal of pressure change will make the error uncertain to some degree.

Altimeters used as secondary standards will have much less spread in their errors at a given reading due to drift and hysteresis if they are originally tested and only used when in the cyclic state. This state is obtained by subjecting them to about five pressure cycles covering their range. Since the altimeter gradually returns to the rested state, the procedure should be repeated if the time between the above procedure and use is much longer than about an hour.

It has not up to the present been practical to apply corrections to aneroid instruments for drift and hysteresis under the varied conditions of service use. In simple cases,

such as an aircraft flight up to an altitude, in which a pressure-time record is obtained on a barograph or otherwise, the instrument can be calibrated under the same flight conditions of temperature, pressure and time reproduced in the laboratory. This is known as a flight history test.

(*d*) *Temperature errors* are the effect of variation in instrument temperature upon the scale errors. The drift and hysteresis are not affected by instrument temperature in any practical amount. In uncompensated instruments the effect of temperature is a maximum at the highest pressure of the range, because the deflection of the pressure element is then greatest. Commonly, in short-range instruments the temperature compensation is such that it is perfect at one pressure only, but in view of the short range, the compensation is sufficiently perfect at other pressures. In long-range instruments, as aviation altimeters, compensation for all readings over the entire range of pressure is desired, which is not as easily accomplished. The latter is often called "range compensation."

The compensation can be made practically perfect but at considerable extra expense because each instrument requires adjustments and tests to achieve it. In practice, tolerances for the temperature error are allowed. Corrections for the error determined by appropriate tests can be applied, although special precautions must be taken in measuring the instrument temperature because of its time lag in following ambient air temperature.

(*e*) *Zero shift,* sometimes called secular error or zero drift, is a change in the whole scale error curve which occurs slowly with time at atmospheric pressure and temperature, but may be accelerated by pressure and temperature cycles. There is no recovery. It usually manifests itself as a pointer motion in the direction of increasing pressure. Its irreversibility, or failure to recover, distinguishes it from the drift previously considered It appears to be caused primarily by the release of trapped fiber stresses in pressure elements which are in the cold-worked condition. The pressure element can be stabilized in this respect by artificial aging or seasoning, which is accomplished by subjecting it or the complete instrument to a combination of pressure and temperature cycles. Particularly effective is an exposure for a short time to a temperature just short of that which will remove the hardening effect of cold work.

Unless accelerated, the zero shift may continue for several years, but at a diminishing rate.

A zero shift, but with an opposite direction of pointer travel, will occur if the diaphragm capsule leaks. Obviously the instrument is unusable in this case. Wear in the bearings of the mechanism, often as a result of rough handling of the instrument, may also cause a zero shift.

(*f*) *Vibration and friction* are especially important in the sensitive aviation altimeter now available. The friction is of the order of 100 feet, but is removed, with a residual uncertainty of about 10 feet by a vibration with an amplitude of about 0.001 inch. Since vibration of considerable amplitude may damage the altimeter, inevitably so if at the natural frequency of the mechanism, the vibration to which it is subjected is controlled by installing the instrument board upon which it is mounted in vibration-absorbing mounts.

Other aneroid instruments are available which are remarkably free from friction. However, it is on the safe side to tap all aneroid instruments slightly to insure a friction-free reading. Instead of tapping, operation of a small bell buzzer attached to the instrument may be preferable in the case of instruments with much friction, in view of the uniformity and relatively high frequency of the vibration thus obtained.

In general, installations in which the aneroid instruments are subjected to severe vibration should be avoided, especially so if there results any sensible pointer vibration.

(*g*) *Shocks* to aneroid instruments lead to damage to the delicate pivots and bearings of high quality instruments. Breakage of the parts may occur. On this account the instruments require protection during shipment. In the field use of surveying aneroid the practice seems to be growing of requiring that shock protection be incorporated inside of the instrument case. The requirement that surveying instruments be rugged

appears to be essential in view of conditions of use in the field.

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ANTHROPOLOGY.—*The De Luna Expedition and the "buzzard cult" in the Southeast.*[1]

James B. Griffin, University of Michigan. (Communicated by John R. Swanton.)

For a great many years American archeologists have been puzzled by a series of resemblances between the Southeastern United States Middle Mississippi cultures and those of the Mexican area, and a considerable amount of time and speculation has been devoted to either explaining the relationship or explaining it away. (Holmes, 1883, was one of the best early studies.) Prominent among these connections has been a series of drawings of dancing figures and other anthropomorphic concepts, placed on shell and pottery, and figures cut out and impressed in copper. By some students these were interpreted as direct Mexican influence that came into the Southeast as the result of a migration (Radin, 1927, pp. 192–202; Nuttall, 1932, pp. 137–144) and produced the Middle Mississippi culture. Others considered these art styles to be the result of some inherent quality in the Indian mind which at a given cultural level would produce similar "Indian art" styles

[1] Read before Society for American Archeology, Washington, May 13, 1944. Received May 20, 1944.

(Thruston, 1890, chap. 9). Others interpreted the Mexicanlike artifacts as objects fabricated in the Southeast by a small group of Mexican exiles. No one suggested that the items were made in Mexico. Willoughby (1932, p. 45) maintained that the designs and craftsmanship, particularly on the copper plates, is Muskhogean and not Mexican, and Phillips reiterated the opinion that the plates did not resemble any known contemporary Mexican work.[2] With regard to the general Mexican resemblances, and particularly the shell gorgets, Phillips said, "To account for this tendency without some sort of contact involves a terrific strain on the theory of 'psychic unity.'"[3] Phillips also recognized, as have others, that the Mexicanlike material was spread like a thin wash in the Southeast and was certainly not part of the "original" Middle Mississippi, whatever and whenever that might have been.

Some students have viewed these art styles as the expression of a religious revival brought about during a fanciful period of decline and decay of southeastern culture (Ford and Willey, 1941, pp. 357–359). In the writer's opinion the art styles resembling Mexican forms are a part of the culture at the highest aboriginal level of accomplishment and represent not a stage of retrogression but the Southeast at its apogee.

The recent archeological activity in the Southeast has demonstrated rather clearly that this particular cultural manifestation is almost certainly post-De Soto (1540) and belongs to a period only shortly before the coming of the French and English traders into the Southeast. During the Third Round Table Conference in Mexico City in 1943, I discussed this art style with Mexican anthropologists, who recognized it as having close relationship to the art forms of the Mixteca-Puebla Culture, which were contemporary with the Conquistadores (Vaillant, 1940, pp. 209–305; comments by Dr. Caso in Mexico City, September, 1943; Ekholm, 1944). In other words, we are dealing with approximately contemporary art manifestations.

[2] This opinion is largely negated in Moore, 1905, pp. 225–227.

[3] Phillips, 1940, p. 356. This is essentially Holmes's position and was seconded by Starr, 1897.

Some individuals had suggested that De Soto might have taken mercenaries or camp followers from Mexico to the Southeast, but there is no record or suggestion that he did so. However, we do have record of another expedition into the Southeast, which may contain an explanation for this interareal connection. In 1559 Tristan de Luna led an expedition to the Gulf coast which was organized in Mexico City for the purpose of establishing a Spanish base on the Gulf coast and on the southeast Atlantic coast to forestall the encroachment into the area of other European powers.[4]

The armed force or striking power of the expedition was furnished by Spaniards from Mexico City, Oaxaca, Los Zacatecas, and Puebla. It is possible that the Spanish soldiers and officers from these areas had local Indians as their servants and camp followers. The expedition left Mexico City in mid-April and moved to Tlaxcala where it remained until May 12. At this point the Viceroy wrote to de Luna regarding the composition of the expedition:

> They tell me that the *canaille* of halfbreeds, mulattoes, and Indians who are being taken by the people (soldiers) are very numerous; you will find that the great part of these will only serve to set the camp in confusion and eat up the supplies. I think it will be enough to send only as many servants as there are soldiers to go, and only those who are to embark should go down from Halapa. (Priestley, 1928, vol. 1, p. 54.)

The sailing date from San Juan de Ulua was June 11, 1559. The party was composed of 500 soldiers, 1,000 servants and colonists (including women, children, Negroes), a large number of Mexican Indians, and 240 horses. They embarked in 13 ships. Advance knowledge and international considerations had set their goal as the port of Ochuse or Polonza (Pensacola Bay), but they sailed past it to the Bahia Filipina (Mobile Bay). A frigate was dispatched east to locate Ochuse, and after this was accomplished the whole fleet arrived at Ochuse on August 14. Exploring parties were sent out, one of which evidently followed the course of the Escambia River. The area about Pensacola

[4] The account of the expedition in this paper has been extracted and condensed from the following publications: Swanton, 1922, pp. 159, 230–239, 240, 254–256; 1939, pp. 209–218; Lowery, 1901, pp. 351–377; Priestley, 1928, 1936.

was not densely populated nor was the Escambia drainage. While these scouting parties were gone, a hurricane blew for 24 hours on August 19 and wrecked all but three small boats and destroyed most of the supplies. When the exploring parties returned and reported that the land was poor and there were few Indians to support them the expedition was faced with an unpleasant future. Another exploring party of 200 Spaniards and "canaille" was sent to penetrate farther into the interior, and some 40 leagues north they found a temporarily abandoned Indian town of 80 houses, called Nanipacana or Nanipacna, on a great river which is probably the Alabama. It was located close to the site of Mabila or perhaps may have been Mabila itself, since the story told by its inhabitants checks with the history of Mabila, and the distance from Mobile Bay to both towns is very close. Halbert thought that Nanipacana was in Wilcox County, while Lowery and Swanton favor a location in Monroe County. Certainly, no very exact information is given in the accounts of the expedition. The name of this town is said to be a Choctaw word meaning "high mountain or hilltop." In this village the scouting party found maize, beans, and other food that had been left by the Indians, who had fled as this new party of Spaniards approached. In the meantime, two vessels with provisions arrived from New Spain, so that de Luna did not move the majority of his party to Nanipacana until early April, 1560. He left a small party at Ochuse to guard the port. This meant that a motley group of 1,500 persons were attempting to live in an Indian village of 80 houses. On April 15 de Luna sent out a party of about 300 under Mateo de Saùz to visit Coosa. They went toward the northeast and, not finding much food, were reduced to dire straits. The first part of June they found provisions and sent back to de Luna 40 bushels of corn from a town called Caxiti (Casiste, a day's march west of Talisi, located at Durand's Bend). Proceeding up the Alabama they stopped at Onachiqui, one of the first Coosa towns which was near the Olibahali River. They did not stay long but journeyed north to Coosa, which turned out to be a community of 30 houses and 7 suburban centers. This town was located on the east side of the Coosa River in Talladega County, between the mouths of Talladega and Tallaseehatchee Creeks. The majority of the party remained at Coosa for at least three months, and one of their most notable exploits was to aid their hosts in a conflict against the Napochies, who have commonly been identified as living to the west, because of the association of their name with Napissa, an Indian group mentioned as being associated with the Chickasaw by Iberville 140 years later and because of the mistaken idea that the Napochies lived near the Mississippi. However, it was only a few days' march from Coosa to the first Napochie town whose inhabitants had fled to the second Napochie town, which was near a river called Oquechiton. This has been identified as the Mississippi, the Yazoo, the Black Warrior, and the Tennessee. As the name given means "the great water," as Padilla states, some historians have concluded that the party reached the Mississippi. The location of the towns is not known.

Meanwhile, the main group at Nanipacana was slowly starving to death, and during June and July serious differences of opinion arose as to the best course to follow. Of particular interest is the June 23 petition, drawn up by the principal Indians and Indian craftsmen from Mexico, urging de Luna to allow them to return. The petition was ignored. De Luna wanted to march north to join Sauz in Coosa, but the majority of the expedition wanted to go back to Mobile Bay. The move south was effected about June 24, 1560, and a message was placed in an urn which was buried beneath a tree with a message placed on the tree for the returning Coosa party to "dig below." Shortly after the main party arrived in Mobile Bay two ships arrived with additional but insufficient supplies so that women, children, and the sick were allowed to embark for Havana and New Spain. At the command of King Philip of Spain, two boats were dispatched to set up a base near Beaufort, S. C., in order to forestall the French from settling along the southeast coast. The main party moved back to Ochuse, where, in August, they received the

messengers from Sauz who reported that the scouting force was getting along fairly well at Coosa. De Luna wished to take the bulk of the able bodied and set up a base at Coosa, but his men refused to follow him, and from September, 1560, to April, 1561, the remainder of the expedition struggled along in Pensacola Bay while the majority of the group sent to Coosa evidently remained there. De Luna's successor, Villafane, had been ordered to establish the base on the southeast Atlantic coast, and in April 1561, he took with him such members of the De Luna Expedition as still had stomach for pioneering. The official records do not pay much attention to the fate of the Indians taken on the expedition or say how many were left in Alabama, returned to Mexico, or perished in the Southeast.

The Indians had been taken along as "C. B." battalions or engineers to build settlements, repair broken equipment, and to undertake all the disagreeable but fundamental tasks that the Spanish were too busy to do for themselves. De Soto had taken Indian women from Coosa and they spent almost 20 years in Mexico. They returned to Coosa with Sauz's party. Thus, for almost two years there was a large group of Mexican Indians from the specific areas where the most profound resemblances to the southeastern late art styles are located, and they were in an area that is quite close to a heavy concentration of objects attributed to Mexican influence.[5] First of these sites is Moundville located on the Black Warrior River, a short distance south of Tuscaloosa, Ala., and which is fairly close to the probable location of the Napochie towns. The other prominent center of Mexicanlike material is at Etowah in Barlow County, Ga., in the headwaters of the Coosa. Both Moundville and Etowah are believed to belong to the later prehistoric archeological period and have been tentatively dated by archeologists at about 1550–1650. On the basis of the archeological data there is little doubt that they were occupied contemporaneously during at least part of their existence, for some of the pottery from Etowah was almost certainly inspired by or directly derived from Moundville, and pipes of the distinctive late North Georgia style have been found at Moundville. Another center where shell objects, suggesting Mexican origin, have been found is around Montgomery. Another major center for the shell disks is in eastern Tennessee.

There have been some theories about the passage along the gulf coast of migratory groups, either by land or by boat, who then moved up the Mississippi and established a center of Middle Mississippi culture. Some such explanation may later be demonstrated for earlier elements of either Middle Mississippi or Hopewellian, but the distributional features of the buzzard-cult artifacts indicates that there was no significant use of such concepts in Texas, Louisiana, Arkansas, or southern Mississippi. There is one famous site that has a considerable amount of material of this nature, namely, Spiro in the Arkansas Valley of eastern Oklahoma, and that question will be dealt with in another paper.

Unfortunately, European-manufactured objects, or items brought into the Southeast from Mexico, have been rarely identified as of this 1560 period. The sole exception known to me so far is a coin and other non-Indian material found by Moore with a burial under a pottery vessel in a mound at Bear Point in Perdido Bay. This was a Mexican silver coin of the 1525–1550 period (Moore, 1901, pp. 423–432). Since the vessel belongs in the Fort Walton period, some of our ideas about cultural chronology in the lower Southeast may be in for a change, depending upon the date at which the coin was deposited. It would seem reasonable that either at Nanipacana or at Coosa some item of Spanish origin would be associated with Indian artifacts so that cross dating might be effected. Many items of European origin have been recovered in the Montgomery area, but the majority of these are evidently of the 1680–1750 period, and the same holds true for the trade goods in comparable sites on the Tennessee.

[5] Ekholm, 1944, pp. 443–444. The reference to "Etowah" should read Moundville. The resemblances between the skull, heart, and long bones on Moundville vases and those in the Mexican Codices is reported in Moore, 1905. This was not mentioned by Phillips, nor was I aware of it at the Round Table Conference. This resemblance was noted by Caso.

It is, therefore, the purpose of this paper to suggest that the De Luna Expedition might well have furnished the impetus that resulted in the adoption in the southeast of various Mexican art styles and concepts. An intensive and considerable amount of research, however, is needed to analyze and compare the various representations in the Southeast and to examine the Mexican records to see the degree of resemblance to the culture of the area from which the De Luna Expedition in 1559 obtained their Indians.

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PALEONTOLOGY.—*A new fossil comatulid from the Cretaceous of Cundinamarca, Colombia.*[1] Austin H. Clark, U. S. National Museum.

Dr. José Royo y Gómez, geologist of the Ministerio de Minas y Petroleos, Bogotá, Colombia, with the consent of the Ministry and of Brother Apolinar María, director of the Museo del Instituto La Salle, has kindly submitted to me for study two unusually interesting specimens of a fossil comatulid from the Cretaceous of Colombia. These are the first comatulids to be reported from the Cretaceous in any area outside of Europe. The specimens are unusually complete, with cirri, division series, arms, and fragmentary pinnules; but they do not show the centrodorsal clearly, and the articular faces of the radials are not visible at all. They represent a remarkable new species quite different from any heretofore known, necessitating the creation of a new genus. This new genus finds its closest association with the family Palaeantedonidae, known from the Upper Cretaceous to Quaternary in England, France, Belgium, Holland, Denmark, southern Sweden, northern Germany, Austria, Hungary, Italy, Algeria, and possibly Sinai, Java, and South Carolina.

Some of the species belonging to certain genera of the family Palaeantedonidae might equally well be referred to the recent family Antedonidae, as for instance certain species of *Palaeantedon.* The specimens under consideration, however, although showing many features which would permit their reference to this family, present others, especially the uniformly short pinnule segments and the strong beaded ornamentation

[1] Received April 3, 1944.

of the distal edges of the brachials, that suggest a rather remote relationship to this group.

I am deeply appreciative of the courtesy and generosity of Dr. Royo and of Brother Apolinar María in affording me the opportunity of studying and reporting upon these most interesting specimens. In honor of Dr. Royo I take pleasure in designating the new genus represented by the name of—

Roiometra, n. gen.

Diagnosis.—A genus of the family Palaeantedonidae including large species (with the centrodorsal 12 mm in diameter) with very numerous (over 100 [C]) very slender cirri composed of elongate proximal and short smooth distal segments; 10 arms composed of short oblong, or nearly oblong, brachials, which have the distal edges ornamented with a row of conspicuous beadlike tubercles; the IBr series 2; and flexible pinnules composed of segments which are not longer than broad.

Genotype.—*Roiometra columbiana*, n. sp.

Occurrence.—Cretaceous of Cundinamarca, Colombia.

Roiometra columbiana, n. sp.

Description.—The surface of the centrodorsal is nowhere visible, but from the pattern of the basal segments of the cirri still adhering the centrodorsal appears to be hemispherical or subconical, about 12 mm broad at the base and about 10 mm high. The pattern of the basal cirrus segments indicates that the cirrus sockets are arranged in very numerous closely crowded alternating rows which, from the rim to the dorsal pole, are probably between 12 and 15, or possibly more, in number. From the small size of the basal cirrus segments it is apparent that the cirrus sockets are very small. The indications are that the bare dorsal pole is very small.

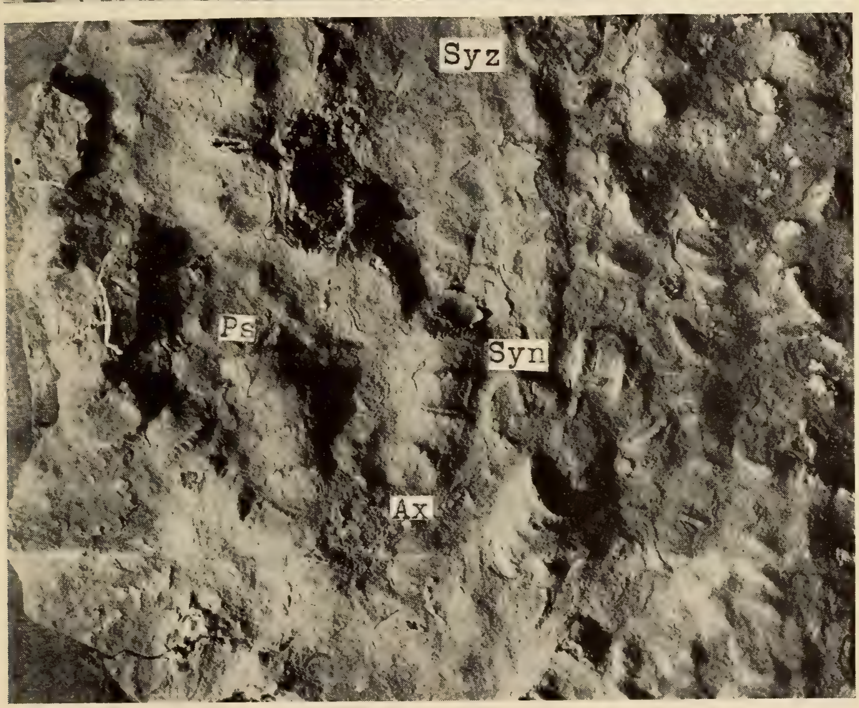
The cirri are exceedingly numerous and very slender, appearing somewhat like a tuft of coarse hair. They are probably well over 100 (C) in number. Most of them appear to be about 27 mm in length, with the longest peripheral cirri about 34 mm and the cirri near the dorsal pole much shorter; the width is from 0.5 to 0.7 mm. They are composed of probably 25–30 segments. In the longest cirri the longest earlier segments are between 3 and 4 times as long as broad, slightly constricted centrally and slightly flaring distally, and the outer segments are from about as long as broad to half again as long as broad with slightly broadened distal ends. The terminal portion of the cirri appears to taper to a point. There are no indications of dorsal or of opposing spines.

The division series and a considerable portion of the arm bases are concealed by the dense mass of cirri. The arms seem to have been 10 in number. They are about 5 mm in diameter, and as far as they are preserved, in one case for 80 mm beyond the cirri, they do not taper. The brachials appear to be between 3 and 4 times as broad as long; the earlier have the ends somewhat oblique, the later have them parallel or nearly so. The distal ends of the earlier brachials are somewhat produced, and from their appearance were either tubercular or spiny. There is no definite evidence of syzygies.

There are many scattered pinnule segments in the matrix between the arms, but most of them are indefinite. They are mostly grouped in short series. From the way in which most of these series are curved it is evident that the pinnules were flexible. Some series of pinnule segments lie across the arms where they simulate a beadlike ornamentation of the brachials. The pinnule segments are all short, none of them being longer than broad. On what appear to be the earlier segments the outer end is produced on the distal side into a high spine. The outer pinnule segments taper proximally to a narrow base.

On the reverse side of the slab, beneath the specimen on the right, a IBr series is visible. The IBr_1 is about 2.5 mm long, and about half again as broad as long; the proximal and distal edges are rather strongly everted and thickened. The IBr_2 (axillary) is about 3.5 mm in length, broader than long, pentagonal, with the lateral borders about two-thirds as long as those of the IBr_1 and making a broadly obtuse angle with them, and the distal edges almost straight and ornamented with a row of 6 or 7 prominent rounded tubercles; the anterior angle measures about 90°.

The first brachial is wedge-shaped, about half again as long exteriorly as interiorly, and about as broad as long in the median line. The distal edge is bordered with a row of tubercles resembling those on the distal edges of the axillaries. The second brachial is less obliquely wedge-shaped, almost oblong though slightly



ROIOMETRA COLUMBIANA, n. sp.

Upper: Two specimens, natural size. *Lower:* Portion of reverse side of slab, beneath the right hand specimen shown above, ×2. Ax = IBr axillary; Ps = pinnule segments; Syn = synarthry; Syz = syzygy. Objects referred to are to the right of the letters, except the synarthry, which is below.

longer exteriorly than interiorly, slightly larger than the first brachial, with the surface slightly concave and the distal border everted and ornamented with a row of about 10 tubercles. As is shown on another arm, the first two brachials are united by synarthry. The third and fourth brachials are united by syzygy, forming a syzygial pair which is somewhat longer than broad; the fourth brachial (epizygal) has the distal edge everted and bordered with a row of tubercles; the distal edge of the third brachial (hypozygal) is unmodified. The right arm is broken off at the distal end of the first syzygial pair. On the left arm the fifth brachial is wedge-shaped, about twice as long exteriorly as interiorly, and short, about three times as broad as the median length. The sixth brachial is similar, but the long and short sides are reversed.

The underside of the slab is almost entirely covered with brachials, mostly in more or less long series, but many as individuals or in small groups. Nearly all these are much worn and so the details can not be made out, though a few are in fairly good condition. Most of the brachials are from 4 to 4.5 mm in diameter, and the outline of the dorsal half is a regular semicircle. The distal edge is everted and somewhat produced, and in the best preserved brachials is tubercular. From the ends of the transverse ridge through which the central canal passes the sides of the brachials converge ventrally in two straight lines making with each other an angle of about 70° to a rather sharply rounded apex; these two converging straight lines are the outer edges of the muscular fossae. Some of the brachials show syzygial faces. These are perfectly developed, with apparently 16–18 radiating ridges.

Together with the brachials there are many pinnule segments, mostly in short series of various lengths, though many are isolated. Some few of these are still in close proximity to the brachials to which originally they were attached. All these pinnule segments are so worn that little can be said about them further than that they are somewhat broader than long, or at least not longer than broad, with more or less constricted proximal ends. A first pinnule segment still attached to a brachial is subtriangular with the apex, adjacent to the brachial, very broadly rounded, slightly broader than long, with a straight distal edge. The pinnule segments are evenly rounded dorsally, and the distal border is usually more or less strongly produced.

Type.—From Naranjillo, Municipio de La Vega, Departamento de Cundinamarca, Colombia; in the Museo del Instituto de La Salle, Bogotá, República de Colombia. From the Middle Villeta formation of the middle Albian, or about middle Cretaceous.

Remarks.—A considerable number of fossil comatulids have been recorded from the Cretaceous of England, Europe, and north Africa. Quite unidentifiable are: *Comatula* sp. Étallon, 1857 (France); *Antedon* sp. Downes, 1880, 1882 (England); *Antedon* sp. Stolley, 1891 (Schleswig Holstein); *Antedon* sp. Jahn, 1895 (Bohemia); *Antedon* sp. Hennig, 1899 (Sweden); and *Eudiocrinus* sp. Brünnich-Nielsen, 1913 (Denmark). Species known only from brachials are: *Antedon granulata* Brünnich-Nielsen, 1913 (Denmark); and *Antedon stevensi* Brünnich-Nielsen, 1913 (Denmark). A species of which the arms are known but the calyx ossicles are only imperfectly described is: *Pachyantedon beyrichi* Jaekel, 1891 (north Germany).

Species in which only the centrodorsal is known are all referred to the genus *Glenotremites* Goldfuss, since their true systematic position cannot be determined. These are: *Glenotremites adregularis* Gislén, 1925 (England); *G. alternata* Gislén, 1925 (England); *G. angelini* Gislén, 1924 (south Sweden); *G. arnaudi* de Loriol, 1894 (south France); *G. batheri* Gislén, 1924 (England); *G. concavus* Schlüter, 1878 (Holland); *G. discoidalis* Gislén, 1925 (Bohemia; Belgium); *G. essenensis* Schlüter, 1878 (west Germany); *G. e.* var. *tuberculatus* Gislén, 1925 (England); *G. excavatus* Gislén, 1925 (England); *G. exilis* de Loriol, 1869 (Switzerland); *G. faxensis* Brünnich-Nielsen, 1913 (Denmark); *G. intermedius* Gislén, 1925 (England); *G. janeti* Valette 1917 (France); *G. laticirrus* P. H. Carpenter, 1880 (England); *G. lettensis* Schlüter, 1878 (west Germany); *G. lundgreni* P. H. Carpenter, 1880 (England); *G. minutissimus* Valette, 1917 (France); *G. paradoxus* Goldfuss, 1831 (north and west Germany; Belgium, England); *G. parvicavus* Gislén, 1924 (Denmark); *G. parvistellatus* Gislén, 1925 (England); *G. parvus* Gislén, 1925 (England); *G. perforatus* P. H. Carpenter, 1880 (England); *G. pusillus* Fritsch, 1910 (Bohemia); *G. pyropa* Zahalka, 1892 (Bohemia);

G. rosaceus Geinitz, 1871 (Bohemia; ?Saxony); *G. rotundus* P. H. Carpenter, 1880 (England); *G. rogosus* P. H. Carpenter, 1880 (England); *G. schlueterianus* Geinitz, 1871 (Saxony); *G. scutatus* Gislén, 1925 (north Germany); *G. semiglobularis* Brünnich-Nielsen, 1913 (Denmark); *G. striatus* P. H. Carpenter, 1880 (England); *G. sulcatus* Schlüter, 1878 (south Sweden); *G. tourtiae* Schlüter, 1878 (west Germany); and *G. valetti* Gislén, 1924 (France; England).

Specimens in which at least the centrodorsal and the basal and radial rings are preserved are capable of more exact systematic allocation. As determined by Prof. Torsten Gislén these fall in the following families and genera: Family Comasteridae: *Palaeocomaster lovéni* P.H. Carpenter, 1880 (England). Family Solanocrinidae: *Solanocrinus almerai* de Loriol, 1900 (Spain); *S. campichei* de Loriol, 1879 (Switzerland); *S. gevreyi* de Loriol, 1902 (France); *S. gillieroni* de Loriol, 1879 (Switzerland); *S. hiselyi* de Loriol, 1869 (Switzerland); *S. humilis* Gislén, 1924 (France); *S. infracretaceus* Ooster, 1871 (Switzerland); *S. leenhardti* de Loriol, 1908 (France); *S. picteti* de Loriol, 1879 (Switzerland); *S. ricordeanus* d'Orbigny, 1850 (France); *S. vagnacensis* de Loriol, 1888 (France); and *S. valdensis* de Loriol, 1868 (Switzerland). Family Conometridae: *Amphorometra alta* Gislén, 1925 (England); *A. brydonei* Gislén, 1924 (England); *A. conoidea* Goldfuss, 1839 (north Germany; Holland); *A. c.* var. *laevis* Gislén, 1924; *A. c.* var. *granulata* Gislén, 1924; *Placometra mortenseni* Gislén, 1924 (England); *Jaekelometra belgica* Jaekel, 1901 (Holland); *J. columnaris* Gislén, 1924 (Holland); and *Conometra rugiana* Gislén, 1924 (north Germany). Family Notocrinidae: *Loriolometra retzii* Lundgren, 1874 (Sweden); *Sphaerometra aequimarginata* P. H. Carpenter, 1880 (England); *S. carentonensis* de Loriol, 1894 (France); *S. incurva* P. H. Carpenter, 1880 (England); *S. semiglobosa* Schlüter, 1878 (Germany); *S. senonica* Gislén, 1925 (England); and *S. teteni* Wegner, 1911 (Germany). Family Palaeantedonidae: *Semiometra bohemica* Gislén, 1925 (Bohemia); *S. courvillensis* Valette, 1917 (France); *S. impressa* P. H. Carpenter 1881 (Sweden); *S. lenticularis* Schlüter 1878 (Holland); *S. minuta* Gislén (England); *S. plana* Brünnich-Nielsen, 1913 (north Germany; Denmark); *S. plana* var. *stellata* Gislén, 1925 (England); *S. pommerania* Gislén, 1924 (north Germany); *S. rowei* Gislén, 1924 (England); *S. scania* Gislén, 1924 (Sweden); *Hertha cava* Brünnich-Nielsen, 1913 (Denmark); *H. mystica* Hagenow, 1840 (north Germany; Belgium); *H. pygmea* Gislén, 1924 (north Germany); *H. suecica* Gislén, 1924 (Sweden); and *Palaeantedon danica* Brünnich-Nielsen, 1913 (Denmark).

Four additional species have not as yet been assigned to the genera now used; these are: *Actinometra batalleri* Astre, 1925 (Spain); *Antedon astellatus* Lehner, 1937 (Germany); *A. bellilensis* Valette, 1935 (north Africa); and *A. chateleti* Valette, 1933 (France).

In determining the systematic relationships of this new species the unidentifiable fragments and the species based upon brachials or arms may be disregarded. It is necessary, however, to consider the numerous species represented only by centrodorsals—assembled under the generic term *Glenotremites*. These species are divisible into two groups. In the first group the centrodorsal is columnar to conical, more rarely discoidal, and the cirrus sockets are large and prominent and arranged in columns, or if they are in a single row they show a distinct transverse ridge. Evidently this new species can not belong here. In the second group the centrodorsal is discoidal to hemispherical and the cirrus sockets are in crowded alternating rows, or if they are in a single row they are without sculpture. The new species is not closely related to any of the described species in this group.

The species in which at least the centrodorsal and the basal and radial circlets are preserved are distributed among the families Comasteridae, Solanocrinidae, Conometridae, Notocrinidae, and Palaeantedonidae. The new species can not belong to the family Comasteridae, in which the centrodorsal is much flattened with the sides never divided into radial areas, and the cirrus sockets are large or absent. It can not belong to the family Solanocrinidae, in which the centrodorsal is discoidal to columnar with the sides never divided into radial areas, and the cirrus sockets are large and arranged in columns or in a single row. It can not belong to the family Notocrinidae, in which the centrodorsal is conical to hemispherical with the sides not divided into radial areas, and the cirrus sockets are large. Finally, it can not belong to the family Conometridae, in the known species of

which the centrodorsal is conical or discoidal with the sides usually divided into definite radial areas by bare stripes or low ridges, each radial area having two columns of rather large cirrus sockets.

This leaves for consideration the family Palaeantedonidae. Gislén defines this family as including species with the centrodorsal varying from sharply flattened to hemispherical, the cirrus sockets small and arranged in closely crowded alternating rows, and the cirri composed of long segments. He says that the species are slender with 10 arms composed of moderately oblique brachials, and that synarthries and syzygies are well developed.

The present species agrees with this definition in having numerous small cirrus sockets; in having the cirri composed, at least in the basal portion, of long segments; in having 10 arms composed of moderately oblique brachials; and in having well developed synarthries and syzygies. The other details can not be determined.

It would seem, therefore, that this species falls within the family Palaeantedonidae, which includes the genera *Semiometra* Gislén (Upper Cretaceous to Eocene), *Hertha* Hagenow (Upper Cretaceous to Miocene), *Discometra* Gislén (Miocene), and *Palaeantedon* Gislén (Upper Cretaceous to Quaternary).

These genera are unfortunately differentiated by characters in the centrodorsal and articular faces of the radials that can not be made out in the present specimens. *Semiometra* appears to be ruled out, as in that genus the centrodorsal is low or flattened, the cirrus sockets are relatively large, and the size is much less. *Hertha* is composed of small species with the centrodorsal not exceeding 5 mm in diameter which have relatively larger cirrus sockets and much fewer cirri. In *Discometra* the centrodorsal is very much flattened, thick discoidal with a large bare dorsal pole. *Palaeantedon*, with a hemispherical centrodorsal, a small bare dorsal pole, and numerous closely set cirrus sockets arranged in alternating rows seems to offer characters nearest to those of the present specimens.

Palaeantedon is known from the Upper Cretaceous of Denmark (*danica* Brünnich-Nielsen); the Eocene of South Carolina (*caroliniana* Gislén); the Miocene of Algeria (*ambigua* Pomel, *cartenniensis* Pomel, *globosa* Pomel, *lineata* Pomel, and *soluta* Pomel); the Miocene of Italy (*minima* Noëlli); the Miocene of Hungary (*depressa* Gislén and *pannonica* Vadász); the Pliocene of Java (*weberi* Sieverts); and the Quaternary of Algeria (*rosacea* Pomel).

These specimens cannot be referred to *Palaeantedon* because of their very much more numerous cirri, the maximum number in that genus being about 50 (L) (in *P. pannonica*). It is probable that if other characters could be determined other differences would be found.

In 1925 Prof. Torsten Gislén created the genus *Gasterometra* based upon a much worn centrodorsal and radial pentagon from the Upper Cretaceous (probably Senonian) of Devon, England to which he gave the name of *Gasterometra polycirra*. He referred the genus *Gasterometra* to the family Palaeantedonidae. The various characters used in the diagnosis of the genus *Gasterometra* can not be made out in the present specimens. But *Gasterometra polycirra* is of large size with the hemispherical centrodorsal 9.2 mm in diameter and 4.2 mm high, and with its whole surface closely studded with a very great number—at least 300 (CCC)—very small cirrus sockets which are distributed in about 10 alternating rows.

In its large size and in the very large number of cirrus sockets *Gasterometra polycirra* is in general agreement with the present specimens, although in these the outline of the centrodorsal can not be traced and none of the cirrus sockets are visible. As *Gasterometra polycirra* and the species represented by the present specimens agree in the very large number of very slender cirri, and in this feature are quite unique among both fossil and recent comatulids, it is probable that they are related, though it is unlikely that they belong to the same genus.

Gislén noted that *Palaeantedon rosacea* Pomel is possibly, as suggested by Pomel himself, identical with *Antedon mediterranea*. In the present specimens the distal segments of the lower pinnules, a few short series of which are preserved in curved rows lying on the dorsal surface of the brachials, are exceedingly short, not longer than broad, with the proximal end constricted. They thus resemble, at least superficially, the lower pinnules found in the subfamily Heliometrinae of the family Antedonidae. In fact, the best general idea of the appearance of these specimens would be conveyed by comparing them to very large individuals of

a species of *Florometra* with exceedingly numerous and slender cirri, brachials with only slightly oblique ends, and short-segmented flexible distal as well as proximal pinnules. But it should be remembered that in the comatulids superficial similarity does not always indicate close relationship.

For the photographs reproduced on the plate I am indebted to Dr. Ray S. Bassler, head curator of geology, United States National Museum.

BOTANY.—*A new species of* Orcuttia *from Baja California.*[1]

JASON R. SWALLEN, Bureau of Plant Industry, Soils, and Agricultural Engineering.

The genus *Orcuttia* Vasey was described in 1886 with a single species, *O. californica*, from Baja California. A second species was described by Vasey in 1891, from Chico, Calif. The genus was known only from these two rare species until recent years when both were collected in California and two new species in addition. A second species from Baja California was discovered in 1942 by Howard Scott Gentry.

Orcuttia fragilis Swallen, sp. nov.

Annua; culmi 15–40 cm longi, multinodosi, erecti vel decumbentes, geniculati, papillosi vel papilloso-pilosi, purpurascentes, e nodis superioribus breviter ramosis; folia 3.5–6.5 cm longa, 6–12 mm lata, plana, acuta, papillosa vel papilloso-pilosa; ligula obsoleta; paniculae densae, breves 5–10 mm latae, parte inferiori inclusa; spiculae 3–8-florae, 6–12 mm longae; glumae aequales, 7 mm longae, acuminatae, marginibus tenuibus hyalinis; lemma infimum 6–7 mm longum, acutum vel subacuminatum, mucronatum, pubescens et pilosum, minute dentatum; palea lemmate paulo brevior, dentata, carinis minute scabris, marginibus tenuibus, hyalinis; antherae 3 mm longae.

Annual; culms 15–40 cm long, many-noded, erect or usually ascending or decumbent at the base, incurved above, geniculate at the lower and middle nodes, the internodes rather short, of nearly equal length, prominently papillose or papillose-pilose, purple, in striking contrast to the pale green leaves, bearing short, appressed, flowering branches from the upper nodes; leaves 3.5–6.5 cm long, 6–12 mm wide, flat, acute, papillose or papillose-pilose, the division into sheath and blade not evident except for a slight constriction at the ligular area, the blade finally breaking off at this line; panicles dense, spikelike, all or partly enclosed in the upper leaves, the exserted portion 1–3 cm long, 5–10 mm wide, or those on the lower branches smaller; spikelets 3–8-flowered, 6–12 mm long; glumes equal, 7 mm long, acuminate, the margins thin, hyaline; lemmas pubescent, especially toward the base, and also sparsely pilose, the lowest 6–7 mm long, acute or subacuminate, the others successively smaller, minutely toothed, the midnerve excurrent as a short mucro; palea a little shorter than the lemma, dentate, minutely scabrous on the keels, the margins broad, thin, hyaline; anthers 3 mm long.

Type in the U. S. National Herbarium, no. 1865489, collected on playa, sandy clay; at Llano Dirai, Magdalena Plain, within the limits of the Sonoran Desert in southern Baja California by H. S. Gentry (no. 4192). "An abundant forage grass over the great flood-plain following rain storage. Reported excellent for cattle."

[1] Received May 20, 1944.

BOTANY.—*A new species of* Hemitelia *from Peru.*[1] William R. Maxon, U. S. National Museum.

The ferns collected in Peru by Mrs. Ynes Mexia in 1931 include the following strongly characterized new species of *Hemitelia*. Among American members of Cyatheaceae it appears unique in indusium characters, notwithstanding the great diversity shown by members of the family in this respect, and I know of none with similar venation.

Hemitelia nervosa Maxon, sp. nov.

§*Cnemidaria*. Rhizomatis vel caudicis fragmentum solum adest, parte apicali dense paleacea, paleis lanceolato-subulatis, longe attenuatis, usque ad 2 cm longis, basi 3–4 mm latis, medio brunneis, scleroticis, lucidis, margine late albido-scariosis, subtiliter fimbriatis. Frons saltem 2-metralis; stipes ca. 70 cm longus, validus, basi curvata brunnea modice verrucosus, sursum antice profunde trisulcatus; lamina ubique nuda et glaberrima, oblonga, 1.3 m longa, ca. 60 cm lata, apice acuta, basin versus non angustata, imparipinnata, rhachi sulcata; pinnae remotae, latere utroque 11, basales oppositae, ceterae suboppositae vel superiores alternae, omnes subaequales, ca. 30 cm longae, 6.5–7.5 cm latae, anguste oblongo-lanceolatae, apice acuminatae, basi subrotundae vel latissime cuneatae, pleraeque petiolulatae (3–8 mm), acumine excepto crasse serratis, serraturis 5–9 mm longis, 1.5–3 (4) mm altis, convexo-curvatis, antice apiculatis; venae usque ad acuminem ca. 40 jugae, utrinque elevatae, venula basali transverse conjunctae, arcu costali 3 vel 4 radiis longe exeuntibus, his varie inter se acute conjunctis; venulae laterales 6–10-jugae, obliquae, apicales breves, liberae, ceterae plerumque cum venulis oppositis et arcuum radiis irregulariter angulo acutissimo anastomosantes, venulis consociatis pellucidis saepe geminis; sori ca. 1.5 mm diam., 6–10-jugi, in zonam latam a costa remotam positi; indusia rotunda, plana, parva, tenere membranacea, primum subintegra et sporangiis numerossimis omnino operta, demum leviter lobata; receptacula magna, globosa, sessilia.

Type in the U. S. National Herbarium, nos. 1615531–533, collected in a gully at mouth of Río Santiago, above Pongo de Manseriche, Departamento de Loreto, Peru, altitude 300 meters, December 18, 1931, by Mrs. Ynes Mexia (no. 6291). Presumably the trunk was decumbent or weakly ascending, attaining a length of less than one meter.

Hemitelia nervosa differs widely from all previously known members of the subgenus or section *Cnemidaria*, especially in venation. The lateral veinlets are elongate, very oblique, and almost without exception unbranched. Of these, the three to five apical pairs are free and run to the curved margin of the serrature. The four or five lower pairs are variously joined to opposed veinlets from the next vein or to the branches running up from the costal arc. The common or combined veins running to the sinuses are variable in width, color, position, and structure, being sometimes single and simple, often single and very acutely once-forked, or not infrequently even distinctly paired. In addition to its curious venation *H. nervosa* is at once distinguished among *Cnemidaria* species by its sharply curvate-serrate margins.

In its flat, circular, delicately membranous indusium *H. nervosa* is unique within the genus, at least as represented in America. A few members of *Euhemitelia*, it is true, have indusia that are rounded in general outline, instead of semicircular, but these are species of distant relationship and the indusia are large, coarse, and divided into several spreading saccate lobes, thus widely different from *H. nervosa*.

[1] Published by permission of the Secretary of the Smithsonian Institution. Received May 20, 1944.

Hemitelia nervosa Maxon

ORNITHOLOGY.—*The subspecies of the gnatcatcher* Polioptila albiloris.[1] PIERCE BRODKORB, University of Michigan. (Communicated by HERBERT FRIEDMANN.)

Study of the black-capped gnatcatchers of Mexico and Central America is complicated by marked sexual dimorphism and in most cases by equally marked seasonal plumage changes. Until recently seasonal changes were not known to occur or were misunderstood. As a result, the several species and subspecies were hopelessly confused, some authors even going so far as to reduce them to a single wide-ranging species. As clearly demonstrated by van Rossem,[2] however, the black-capped gnatcatchers are divisible into three major groups which may be summarized as follows:

A. Cap of male black only in summer; winter male gray-capped like the female at all seasons.
Polioptila nigriceps (northwestern Mexico)
AA. Cap of male black at all seasons.
B. Loral and superciliary regions of male black in summer, partially white only in winter
Polioptila albiloris (southern Mexico and northern Central America)
BB. No season change; loral and superciliary regions always entirely white.
Polioptila plumbea (Central and South America)

Van Rossem recognized the *nigriceps* forms as constituting a specific unit, but he reluctantly combined the *albiloris* forms in the same specific unit with *bilineata*, because the two groups were said by others to intergrade. Zimmer[3] placed *albiloris* in a separate specific unit from *bilineata*, which latter he considered a subspecies of *Polioptila plumbea*. He stated that *albiloris* and *Polioptila plumbea superciliaris* occur together without intergradation in parts of Nicaragua and Costa Rica. In view of the confusion that existed previous to van Rossem's work, I am inclined to follow Zimmer in disregarding the earlier claims of intergradation between these two forms, especially since I find no evidence of intergradation among the specimens examined by me.

The species here understood as *Polioptila albiloris* inhabits parts of Mexico and Central America below 1,000 meters altitude, from the state of Nayarit to Costa Rica. It is a bird of arid regions and is thus largely confined to the Pacific side of the continent. It occurs also in arid localities on the Atlantic side in northwestern Oaxaca, in the Grand Valley of Chiapas, on the tip of the Yucatán Peninsula, in the Motagua Valley of Guatemala, and in the interior of Honduras. Within the area outlined above the known distribution of the species is spotty. Several of the apparent gaps in its range are undoubtedly due to lack of exploration. Others are real and divide the range of the species into at least three isolated regions. One such area is the tip of the Yucatán Peninsula. A second is the remainder of the Mexican range of the species outlined above. The third is the Central American part of the range. The last area consists of two sections, on the Atlantic and Pacific sides of Central America, respectively. It is as yet unknown whether these two colonies meet.

Some order may be made of the spotty nature of the range of *Polioptila albiloris* when the distribution of other species of the genus is considered. On the Pacific side the northern limits of *albiloris* are practically coterminous with the southern limits of *Polioptila nigriceps nigriceps*. The southern boundaries of the range of *albiloris* overlap slightly the northern boundaries of the range of *Polioptila plumbea superciliaris*. On the Atlantic side the range of *albiloris* ceases approximately at the beginning of the ranges of *Polioptila caerulea deppei*, *Polioptila caerulea nelsoni*, and *Polioptila plumbea superciliaris*, from north to south, respectively.

In a few places *Polioptila albiloris* has been recorded as occurring together with other resident gnatcatchers. It has been recorded with *Polioptila caerulea deppei* at Tehuantepec and Santa Efigenia, Oaxaca, and at Gualán, Guatemala. *Polioptila caerulea caerulea* is not an uncommon winter visitant in these regions, and since the differences between *deppei* and *caerulea* are

[1] Received March 25, 1944.
[2] *Concerning some Polioptilae of the west coast of Middle America*, Auk **48**, 33–39. 1931.
[3] *Studies of Peruvian birds: No. XLII*, Amer. Mus. Nov., No. 1168: 1–6. 1942.

not very pronounced, it is possible that the above records of *deppei* may have been based on migrants of *caerulea.* All authentic specimens of *deppei* which I have examined are from the Gulf lowlands of Mexico.

Polioptila albiloris albiventris has been recorded from Cozumel Island, where *P. caerulea cozumelae* breeds. This record, based upon two Gaumer-taken specimens, is perhaps open to doubt, since no subsequent collector has found the black-capped species on Cozumel.

Nelson and Goldman collected both *Polioptila albiloris* and *P. caerulea nelsoni* at San Vicente, Chiapas, on the edge of the range of both species.

In parts of Nicaragua and in northwestern Costa Rica *P. albiloris* and *P. plumbea superciliaris* occur together.

In spite of the isolation of several of the populations of *Polioptila albiloris,* subspecific differentiation has not progressed far. This fact possibly argues for the comparatively recent expansion of the species into suitable areas which were at the time unoccupied by other members of the genus.

Acknowledgments.—For the use of material I am indebted to Merriam L. Miles and to the authorities of the Academy of Natural Sciences of Philadelphia, the Donald R. Dickey collection at the University of California at Los Angeles, the Chicago Natural History Museum, the U. S. Fish and Wildlife Service, the Museum of Comparative Zoology, and the United States National Museum. This study was aided by a grant from the Faculty Research Fund by the board of governors of the Horace H. Rackham School of Graduate Studies in the University of Michigan.

Polioptila albiloris vanrossemi, n. subsp.

Polioptila nigriceps [nec Baird] Lawrence, U. S. Nat. Mus. Bull. 4: 12. 1876 (Quiotepec, Tapana [=Tapanatepec], and Santa Efigenia, Oaxaca).—Salvin and Godman, Aves, Biol. Centrali-Amer. **1**: 52, part. 1879 (Quiotepec, Tapana, and Santa Efigenia).—Sumichrast, Naturaleza **5**: 241. 1882 (Quiotepec, Tapanatepec, and Santa Efigenia, Oaxaca; Tonalá, Chiapas).—Ridgway, Proc. U. S. Nat. Mus. **5**: 387, part. 1882 (Oaxaca and Tehuantepec).—Herrera, Naturaleza, ser. 2, **3**: 196, part. 1899 (Quiotepec, Tapana, and Santa Efigenia).—Ridgway, U. S. Nat. Mus. Bull. 50, pt. 3: 729, part. 1904 (Cuicatlán, Quiotepec, Puerto Ángel, Tehuantepec, Huilotepec, Tapana, and Santa Efigenia, Oaxaca).—Bangs and Peters, Bull. Mus. Comp. Zool. **68**: 398. 1928 (Chivela and Tapanatepec, Oaxaca).

Polioptila nigriceps nigriceps Hellmayr, Tierreich, pt. 18: 25, part. 1903 (Oaxaca and Tehuantepec).—Hellmayr, *in* Wytsman, Genera avium, pt. 17: 17, part. 1911 (Oaxaca).

Polioptila bilineata nigriceps Griscom, Bull. Mus. Comp. Zool. **75**: 398, part. 1934 (Coyuca, Guerrero).[4]

Polioptila albiloris [nec Sclater and Salvin] Lawrence, U. S. Nat. Mus. Bull. 4: 12. 1876 (Santa Efigenia and Tehuantepec City, Oaxaca).—Salvin and Godman, Aves, Biol. Centrali-Amer. **1**: 53, part. 1879 (Tehuantepec and Santa Efigenia).—Sumichrast, Naturaleza **5**: 241. 1882 (Tehuantepec, Cacoprieto, and Santa Efigenia, Oaxaca).—Ridgway, Proc. U. S. Nat. Mus. **5**: 387, part. 1882 (Tehuantepec, Santa Efigenia, and Tapana, Oaxaca).—Sharpe, Cat. Birds Brit. Mus. **10**: 454, part. 1885 (Tehuantepec).—Ridgway, Man. North Amer. Birds, p. 569, part. 1887 (Tehuantepec).—Herrera, Naturaleza, ser. 2, **3**: 196, part. 1899 (Tehuantepec and Santa Efigenia).—Sharpe, Hand-list **3**: 242, part. 1901 (west Mexico).—Hellmayr, Tierreich, pt. 18: 28, part. 1903 (Isthmus of Tehuantepec).—Ridgway, U. S. Nat. Mus. Bull. 50, pt. 3: 725, part. 1904 (Cuicatlán, Tehuantepec, Huilotepec, Santa Efigenia, and Tapana, Oaxaca; description; measurements; bibliography).

Polioptila albiloris albiloris Hellmayr, *in* Wytsman, Genera avium, pt. 17: 16, part. 1911 (Oaxaca).—Zimmer, Amer. Mus. Nov., No. 1168: 1, 2, 6, part. 1942 (Tapana and Santa Efigenia; criticism; measurements).

Polioptila bilineata albiloris Griscom, Amer. Mus. Novit., No. 414: 7, part. 1930 (Tehuantepec and Chivela; criticism).—van Rossem, Auk **48**: 34, part. 1931 (Atlantic drainage of southern Mexico).—Dickey and van Rossem, Publ. Field Mus. Nat. Hist., Zool. ser., **23**: 462, in text, part. 1938 (Atlantic drainage of Chiapas).

Polioptila plumbea albiloris Hellmayr, Publ. Field Mus. Nat. Hist., Zool ser., **13**, pt. 7: 504, part. 1934 (southern Mexico).

Polioptila bilineata [nec Bonaparte] Sharpe, Hand-list **3**: 242, part. 1901 (Mexico).

Polioptila bilineata bairdi [nec Ridgway] van Rossem, Auk **48**: 35, part. 1931 (San Blas, Nayarit).—Dickey and van Rossem, Publ. Field Mus. Nat. Hist., Zool. ser., **23**: 462, in text, part. 1938 (San Blas).

Polioptila plumbea bairdi Hellmayr, Publ. Field Mus. Nat. Hist., Zool. ser., **13**, Pt. 7 505, part. 1934 (Santiago and San Blas, Nayarit; Iguala and Tierra Colorada,

[4] The specimens from Chilpancingo prove upon examination to be *Polioptila caerulea nelsoni.*

Guerrero; Sierra Santo Domingo, Tehuantepec, and Salina Cruz, Oaxaca).—Blake and Hanson, Publ. Field Mus. Nat. Hist., Zool. ser. **22**: 542. 1942 (Apatzingán, Michoacán).

Type.—U.S.N.M. 54441; adult male; Quiotepec, District of Cuicatlán, Oaxaca; August 8, 1868; Francis Sumichrast, original number 12.

Characters.—Agrees with other races of *Polioptila albiloris* in having the cap of the male constantly black after the postjuvenal molt; loral and superciliary regions of male entirely black in breeding plumage; loral and superciliary regions of both sexes largely white in winter but with a dark spot (black in male, dusky in female) at anterior corner of eye and with a broad dark postocular stripe.

Differs from other subspecies of *Polioptila albiloris* in having the wing and especially the tail longer; the tail always longer than the wing. Differs further from *P. albiloris albiventris* in darker dorsal and ventral coloration.

Range.—Southern Mexico in the interior and in the Pacific lowlands, from Nayarit (Santiago and San Blas), Michoacán, (Apatzingán), Guerrero (Coyuca, Acapulco, Tierra Colorada, and Iguala), Oaxaca (Quiotepec, Cuicatlán, Puerto Ángel, Tehuantepec, Huilotepec, Salina Cruz, Chivela, Sierra Santo Domingo, Santa Efigenia, and Tapanatepec), to Chiapas (Arriaga, Tonalá, Tuxtla Gutiérrez, San Bartolomé, San Vicente, and Chicomuselo).

Remarks.—The characters of this form are best developed in the District of Cuicatlán, northwestern Oaxaca. Whether its range is continuous from that district across to the Pacific coast is at present unknown. Specimens from the coast, from Acapulco to Puerto Ángel, are slightly atypical. Those from the Grand Valley of Chiapas, while still less typical, are yet closer to the Oaxaca birds than they are to Central American specimens. Birds from the Isthmus of Tehuantepec and the Pacific coast of western Chiapas, on the other hand, resemble *bairdi* at least as much as they do *vanrossemi*. Nevertheless, in view of the hiatus in the range of the species along the Pacific coast between the isthmus and El Salvador, I have thought it expedient to refer the whole Mexican colony to *vanrossemi*.

Zimmer suspected the existence of a long-tailed Mexican subspecies, although the only specimens which he was able to examine were from the intergrading population of the Isthmus of Tehuantepec.

Specimens examined.—Guerrero (Acapulco, 3). Oaxaca (Quiotepec, 1, type; Cuicatlán, 3; Puerto Ángel, 1; Chivela, 3; Tehuantepec, 4; Huilotepec, 2; Santa Efigenia, 2; Tapanatepec, 1). Chiapas (Arriaga, 4; Tonalá, 9; Tuxtla Gutiérrez and vicinity, 11; San Bartolomé, 2; San Vicente, 1; Chicomuselo, 2). Total, 49.

Polioptila albiloris albiventris Lawrence

Polioptila albiventris Lawrence, Ann. New York Acad. Sci. **3**: 273. 1885 (Temax, Yucatán; original description).—Ridgway, Man. North Amer. Birds, p. 569. 1887 (Yucatán; characters).—Stone, Proc. Acad. Nat. Sci. Philadelphia, 1890: 211 (Progreso, Yucatán).—Hellmayr, Tierreich, pt. 18: 24, 1903 (Yucatán).—Ridgway, U. S. Nat. Mus. Bull. 50, pt. 3: 729. 1904 (Temax and Progreso; characters; measurements; bibliography).

Polioptila nigriceps albiventris Hellmayr, *in* Wytsman, Genera avium, pt. 17: 16. 1911 (Yucatán).

Polioptila bilineata albiventris Griscom, Amer. Mus. Nov., No. 414: 7. 1930 (outer third of Yucatán Peninsula; criticism).

Polioptila plumbea albiventris Hellmayr, Publ. Field Mus. Nat. Hist., zool. ser., 13, pt. 7: 503. 1934 (Temax, Mérida, Progreso, and Cozumel Island; criticism; characters).

Polioptila albiloris albiventris Zimmer, Amer. Mus. Nov., No. 1168: 2, 6. 1942 (Temax; criticism; type in American Museum).

Polioptila bilineata [nec Bonaparte] Boucard, Proc. Zool. Soc. London, 1883: 439 (Progreso).—Salvin, Ibis, ser. 5, **6**: 246. 1888 (Cozumel Island).

Polioptila nigriceps [nec Baird] Sharpe, Cat. Birds Brit. Mus. **10**: 447, part. 1885 (Mérida, Yucatán).

Characters.—Paler on dorsal and ventral surfaces than any of the other subspecies of *Polioptila albiloris*. Agrees with *vanrossemi* in always having the tail longer than the wing, but differs in having the wing and especially the tail of lesser dimensions.

Range.—Northern Yucatán (Progreso, Temax, and Mérida). Cozumel Island?.

Specimens examined.—Yucatán (Progreso, 12).

Polioptila albiloris albiloris Sclater and Salvin

Polioptila albiloris Sclater and Salvin, Proc. Zool. Soc. London, 1860: 298 (original description; Motagua Valley, Guatemala).—Salvin and Sclater, Ibis **2**: 397. 1860 (Choacus [= Chuacús], Guatemala; type locality).—Owen, Ibis **3**: 61.

pl. 2, fig. 3. 1861 (Choacus; description of nest and eggs).—Gray, Hand-list 1: 237. 1869 (Guatemala).—Sclater and Salvin, Nomenclator Avium Neotrop., p. 4. 1873.—Salvin and Godman, Aves, Biol. Centrali-Amer. 1: 53, pl. 5, figs. 1, 2. 1879 (Chuacús).—Ridgway, Proc. U. S. Nat. Mus. 5: 387, part. 1882 (Guatemala).—Sharpe, Cat. Birds Brit. Mus. 10: 454, part. 1885 (Chuacús; types in British Museum; description; bibliography).—Ridgway, Man. North Amer. Birds, p. 569, part. 1887 (Guatemala).—Herrera, Naturaleza, ser. 2, 3: 196, part. 1899 (Guatemala).—Hellmayr, Nov. Zool. 7: 536, in text. 1900 (criticism).—Sharpe, Hand-list 3: 242, part. 1901 (Guatemala).—Hellmayr, Tierreich, pt. 18: 28, part. 1903 (Guatemala).—Ridgway, U. S. Nat. Mus. Bull. 50, pt. 3: 725, part. 1904 (Chuacús; bibliography).—Dearborn, Publ. Field Mus. Nat. Hist., orn. ser., 1: 136. 1907 (E. Rancho and Gualán, Guatemala).

Polioptila albiloris albiloris Hellmayr, *in* Wytsman, Genera Avium, pt. 17: 16, part. 1911 (Chuacús).—Zimmer, Amer. Mus. Nov., No. 1168: 1, 2, 6, part. 1942 (Progreso, Guatemala; criticism; measurements).

Polioptila bilineata albiloris Griscom, Amer. Mus. Nov., No. 414: 7, part. 1930 (Motagua Valley, from Progreso to Gualán, Guatemala; criticism; reduces *nigriceps*, *restrica*, and *bairdi* to synonymy).—van Rossem, Auk 48: 34, part. 1931 (interior Guatemala; criticism; measurements; seasonal changes).—Griscom, Bull. Amer. Mus. Nat. Hist. 64: 288. 1932 (Progreso, Guatemala).—Carriker and de Schauensee, Proc. Acad. Nat. Sci. Philadelphia 87: 439. 1935 (Gualán, [San Pablo near] Zacapa, El Rancho, and Marajuma, Guatemala).—Dickey and van Rossem, Publ. Field Mus. Nat. Hist., zool. ser., 23: 462, in text, part. 1938 (Atlantic drainage of northern Central America; criticism).

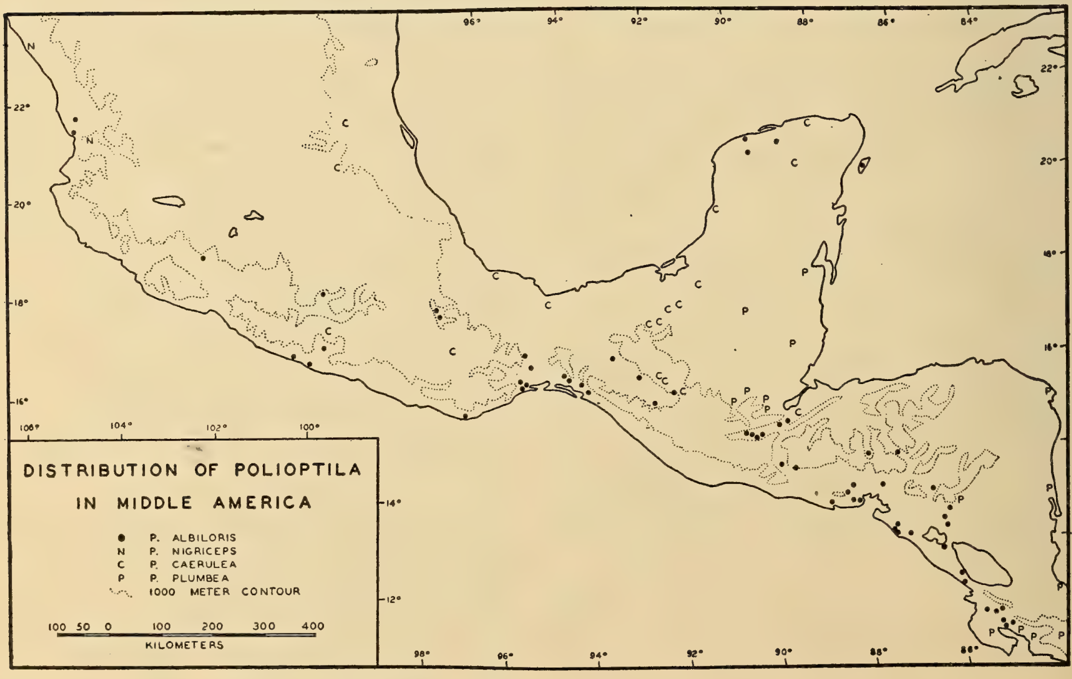
Polioptila plumbea albiloris Hellmayr, Publ. Field Mus. Nat. Hist., zool. ser., 13, pt. 7: 504, part. 1934 (Chuacús, El Rancho, and Gualán; bibliography).

Polioptila bilineata [nec Bonaparte] Stone, Proc. Acad. Nat. Sci. Philadelphia 84: 331. 1932 (Cantarranas, Honduras).

Polioptila bilineata bairdi [nec Ridgway] Dickey and van Rossem, Publ. Field Mus. Nat. Hist., zool. ser., 23: 461, part. 1938 (Lake Guija and San José del Sacare, El Salvador).

Characters.—Differs from *Polioptila albiloris albiventris* in darker dorsal and ventral coloration and in having the tail but little if any longer than wing (tail usually shorter than wing). Differs from *Polioptila albiloris vanrossemi* in having a shorter wing and much shorter tail.

Range.—Motagua Valley of Guatemala (Chuacús, Marajuma, Progreso, El Rancho, San Pablo, and Gualán), the interior of El Salvador (Laguna Guija and San José del Sacare), and the interior of Honduras (Monte Redondo, Comayaguela, Cerro Cantoral, San



Lorenzo, Montaña Vasquez, Hatillo, Cantarranas, and La Flor Archaga).

Specimens examined.—Guatemala (Gualán, 5; San Pablo, 1; El Rancho, 9; Progreso, 4; Marajuma, 1). El Salvador (Lake Guija, 3; San José del Sacare, 1). Honduras (Monte Redondo, 8; Comayaguela, 2; La Flor Archaga, 5; San Lorenzo, 3; Hatillo, 2; Montaña Vasquez, 1; Cerro Cantoral, 1). Total 46.

Polioptila albiloris bairdi Ridgway

Polioptila bairdi Ridgway, Proc. Biol. Soc. Washington **16**: 110. Sept. 30, 1903 (original description; San Juan del Sur, Nicaragua, type in U. S. National Museum; Costa Rica); U. S. Nat. Mus. Bull. 50, pt. 3: 726. 1904 (Realejo, Grenada, Sucuyá, and San Juan del Sur, Nicaragua; Liberia, Volcán de Miravalles, and Cartago [?], Costa Rica; description; measurements; bibliography).—Carriker, Ann. Carnegie Mus. **6**: 751. 1910 (Bagaces, Miravalles, Bebedero, and Ciruelas, Costa Rica).

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Polioptila bilineata albiloris Griscom, Amer. Mus. Nov., No. 414: 7, part. 1930 (northwest Costa Rica; western Nicaragua; criticism).

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Polioptila bilineata [nec Bonaparte] Salvin and Godman, Aves, Biol. Centrali-Amer. **1**: 52, part. 1879 (La Unión, E. Salvador).—Nutting, Proc. U. S. Nat. Mus. **6**: 380, part. 1883 (Sucuyá, Nicaragua).—Sharpe, Handlist **3**: 242, part. 1901 (Central America).

Polioptila nigriceps [nec Baird] Salvin and Godman, Aves, Biol. Centrali-Amer. **1**: 52, part. 1879 (La Unión, El Salvador).—Sharpe, Cat. Birds Brit. Mus. **10**: 447, part. 1885 (La Unión).—Herrera, Naturaleza, ser. 2, **3**: 196, part. 1899 (San Salvador).—Sharpe, Hand-list **3**: 241, part. 1901 (Salvador).—Ridgway, U. S. Nat. Mus. Bull. 50, pt. 3: 729, part. 1904 (Pacific coast of Central America).

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Polioptila nigriceps restricta [nec Brewster] Hellmayr, Nov. Zool. **7**: 536–538. 1900 ([Bebedero,] Costa Rica).

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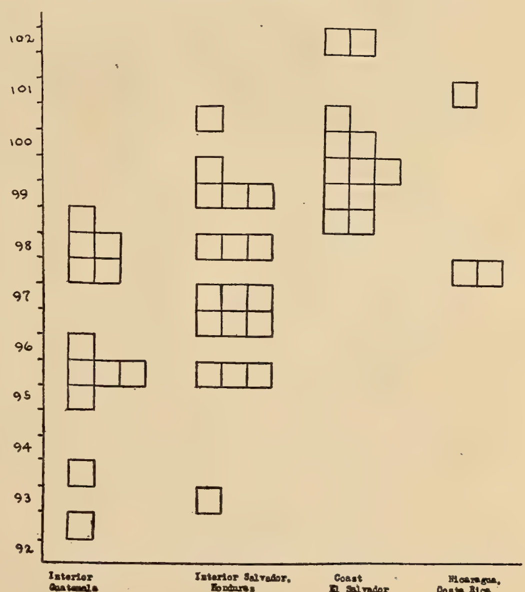

FIG. 2.—Wing length plus tail length (mm.) in *Polioptila albiloris albiloris* and *P. a. bairdii*. Each square represents one specimen.

Polioptila superciliaris superciliaris [nec Lawrence] Ridgway, U. S. Nat. Mus. Bull. 50, pt. 3: 727, part. 1904 (La Unión, El Salvador).
Polioptila ——— (?) Underwood, Ibis, ser. 7, 2: 432. 1895 (Miravalles, Bebedero, and Bagaces, Costa Rica).

Characters.—Differs from *Polioptila albiloris albiloris* only in slightly longer wing and tail.

Range.—Pacific lowlands of eastern El Salvador (west to the Río Lempa), Nicaragua, and northwestern Costa Rica (east to the Río Tenorio).

Remarks.—Zimmer synonymized *bairdi* with *albiloris*, since he was unable to find any stable character by which to separate it. Coastal birds tend to have both the wing and the tail longer than those *albiloris* from the interior, but only slightly more than half of my specimens can be determined by using the measurements of the wing and tail separately. By adding the individual wing and tail measurements, however, a clear division results. All the males from the coast of El Salvador have a wing-plus-tail measurement of 98.5 mm. or more, whereas that measurement in *albiloris* from the Motagua Valley of Guatemala is 98.5 mm. or less. Birds from interior El Salvador and interior Honduras are somewhat intermediate, but are closer to *albiloris* than to the coastal race.

The single Nicaraguan specimen examined (the type of *bairdi*) and the few skins from Costa Rica seem to agree fairly well with those from the coast of El Salvador, but the series is not ample enough to demonstrate this conclusively. Examination of larger series from southern Nicaragua and from Costa Rica, is desirable, since the possibility exists that *Polioptila albiloris albiloris* may cross over to the Pacific side in that region, as several other Caribbean forms do. In that event the name *bairdi* would become a synonym of *albiloris*, and the coastal birds of El Salvador would need another name.

Specimens examined.—El Salvador (Puerto del Triunfo, 1; Volcán de San Miguel, 1; Río San Migual, 5; Divisadero, 9; Laguna Olomega, 6; Volcán de Conchagua, 2; Río Goascorán, 1). Nicaragua (San Juan del Sur, 1, type). Costa Rica (Punta Piedra, 5). Total, 31.

Table 1.—Measurements (in mm.) of Polioptila albiloris

Number	Locality	Wing	Tail	Culmen	Wing plus tail
3 ♂	District Cuicatlán, Oaxaca	48.5–52 (50.0)	52.5–57.5 (54.7)	12.5–13 (12.8)	101 –109.5 (104.7)
3 ♂	Acapulco to Puerto Ángel	46 –50 (48.5)	47.5–53.5 (50.5)	13.5–14 (13.8)	93.5–103 (99.0)
10 ♂	Grand Valley, Chiapas	48 –52 (50.0)	48.5–53 (51.4)	13 –14 (13.5)	96.5–105 (101.4)
6 ♂	Isthmus of Tehuantepec	47.5–50.5 (49.4)	47 –50.5 (48.6)	13 –14 (13.4)	95.5–101 (98.0)
9 ♂	District Tonalá, Chiapas	47 –51 (49.1)	48 –51.5 (49.8)	13.5–15 (14.4)	97 –101 (98.6)
12 ♂	Motagua Valley, Guatemala	47.5–49.5 (48.6)	44.5–49.5 (47.5)	13.5–14 (13.8)	92.5– 98.5 (96.1)
18 ♂	Interior Salvador, Honduras	48 –51 (49.3)	44.5–50 (48.0)	12.8–15 (13.5)	93 –100.5 (97.3)
14 ♂	Coast of El Salvador	49 –51 (50.1)	48.5–51 (49.7)	12.5–14.5 (13.9)	98 –102 (99.8)
4 ♂	Nicaragua, Costa Rica	49.5–52.5 (50.7)	46.5–48.5 (47.6)	14 –14.5 (14.2)	97.5–101 (98.7)
8 ♂	Yucatán	44.5–48 (46.8)	45.5–50.5 (48.6)	12 –14 (13.1)	90 –98 (95.4)
1 ♀	District Cuicatlán, Oaxaca	49	51.5	12.5	100.5
1 ♀	Acapulco, Guerrero	46	48.5	12.5	94.5
6 ♀	Grand Valley, Chiapas	46 –49.5 (47.8)	47.5–50.5 (49.3)	13 –14 (13.5)	93.5– 99 (97.1)
6 ♀	Isthmus of Tehuantepec	45.5–49 (47.6)	47 –50 (48.2)	12.5–13.5 (13.1)	93 – 98.5 (95.6)
4 ♀	District Tonalá, Chiapas	46 –49 (47.3)	47 –51.5 (48.4)	13.5–14.5 (14.1)	93.5–100.5 (95.6)
8 ♀	Motagua Valley, Guatemala	45.5–49 (47.1)	45.5–48 (46.6)	13.5–14 (13.6)	91.5– 95 (93.6)
7 ♀	Interior Honduras	45.5–51 (47.7)	45 –48.5 (46.3)	12 –14.5 (13.3)	91– 97 (94.0)
10 ♀	Coast of El Salvador	47 –52.5 (48.2)	44.5–50 (47.7)	13 –14 (13.4)	91.5–102.5 (95.9)
2 ♀	Costa Rica	47 –48.5 (47.8)	46.5–47.5 (47.0)	13 –14.5 (13.8)	94.5–95 (94.8)
4 ♀	Yucatán	45.5–47.5 (46.3)	48.5–49 (48.8)	12.8–13.5 (13.2)	94 – 96 (95.0)

Table 2.—Proportions (Percent) in Polioptila albiloris

Number	Locality	Wing/Tail	Culmen/Tail
4 ♂ ♀	District Cuicatlán, Oaxaca	90.4– 95.1 (92.4)	22.6–24.8 (23.7)
4 ♂ ♀	Acapulco to Puerto Ángel	92.5– 99.0 (95.8)	25.8–28.4 (27.0)
16 ♂ ♀	Grand Valley, Chiapas	92.1–100.0 (97.1)	25.0–28.3 (26.7)
12 ♂ ♀	Isthmus of Tehuantepec	95.8–106.4 (100.2)	26.7–28.1 (27.3)
13 ♂ ♀	District Tonalá, Chiapas	93.2–103.1 (98.0)	27.0–33.3 (29.3)
20 ♂ ♀	Motagua Valley, Guatemala	97.0–107.9 (101.9)	27.3–31.5 (29.3)
25 ♂ ♀	Interior Salvador, Honduras	96.0–110.9 (102.9)	26.1–32.3 (28.3)
24 ♂ ♀	Coast of El Salvador	96.0–105.6 (100.9)	25.0–30.3 (28.0)
6 ♂ ♀	Nicaragua, Costa Rica	98.9–108.2 (104.0)	27.4–31.2 (29.7)
12 ♂ ♀	Yucatán	92.9– 98.9 (97.5)	24.0–28.6 (26.9)

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JOURNAL
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VOLUME 34 OCTOBER 15, 1944 No. 10

ANTHROPOLOGY.—*Filed Indian teeth from Illinois.*[1] T. D. STEWART, U. S. National Museum, and P. F. TITTERINGTON, St. Louis, Mo.

Evidence that tooth mutilation was practiced by the American Indians has been found mainly in parts of Middle America and in Ecuador in South America. Inlay was practiced in both of these areas, but filing seems to have been restricted chiefly to Middle America (Linné, 1940). With the importation of Negroes in historic times the African custom of chipping the teeth was superimposed to some extent upon the native practice and certainly was introduced into parts of Middle and South America formerly free from any form of dental mutilation (Stewart, 1942).

North of Mexico there has been heretofore no very certain evidence for, and much negative evidence against, the existence of the custom. Although thousands of skulls from North America have been the subject of general study, only one, so far as we can discover, has been described in print as having filed teeth. This exceptional specimen is from the Pueblo region of Arizona. The description of it is contained in a footnote in which Saville (1913, p. 378) defends a statement attributed to him by Lasch (1901) to the effect that the custom could be traced from the Pueblo region to southern Central America: "Regarding the Pueblo region, I made the statement after having photographed a skull found by Dr. Fewkes at Sikyatki, Arizona, a study of which seems to me clearly to indicate single serrations in at least three of the upper incisors and in the lower right lateral incisor." Unfortunately, Saville did not reproduce the photograph of these teeth, and it cannot now be located. The skull, catalogued in the U. S. National Museum as no. 156319,[2] in the meantime has been sent in exchange to the Museum of South Australia. For the present, therefore, all that can be said is that Saville's description of the mutilation pattern in this specimen is too vague to permit identification with any of those from Middle America with which we are familiar.

In spite of this seeming rarity of dental mutilation in North America, many anthropologists probably will not be surprised to learn that undoubted examples now have been found in the Mississippi Valley, because they have become increasingly aware of indications of late prehistoric contact between our Southeast and Mexico (cf. Phillips, 1940). The new specimens are four in number and come from a small area within a radius of 40 miles of St. Louis, Mo. These specimens will be described not in the order of their recovery but in the order in which the mutilation was recognized.

DESCRIPTION

Jersey County bluff skeleton.—The first specimen was excavated by one of us (P. F. T.) in 1935 in a Jersey County bluff mound located 18 miles above the mouth of the Illinois River and designated as number 12 (Titterington, 1935; fig. on p. 11 and pl. 1, fig. 1). The skeleton, being the fifth encountered in this mound,[3] was designated Jy°12-5. It was discovered extended on the back at a depth of 2 feet, and 4½ feet from

[1] Published by permission of the Secretary of the Smithsonian Institution. Received June 9, 1944.

[2] The identification of the skull is based on a note made by Hrdlička years ago when he measured it. "Filing of all incisors."

[3] A disturbed area contained fragmentary bones of at least three additional individuals.

the north end of the mound. No artifacts accompanied this burial, but mussel shell spoons, bone awls (split tibia of deer, leg bone of turkey), and a corner notched white flint knife were found with the other burials. From the time of excavation until the dental mutilation was recognized recently by one of us (T. D. S.) there seemed to be nothing, except perhaps burial position and light bone color, to distinguish this individual from others of the same and adjacent mounds. Extended burials are rather uncommon in these mounds, having been observed in only 5 per cent of 852 burials (Titterington, 1943). Curiously, all but one of the five burials in mound 12 were found lying on the back or side, either fully extended or with the knees slightly flexed. The lighter color and perhaps softer texture of skeleton no. 5 are of doubtful significance and under ordinary circumstances would not have merited attention; they are such as are sometimes seen resulting from peculiarities in soil and drainage.

This individual is a male and about 25 years of age. The age can be fixed fairly closely by the fact that the epiphyses of the iliac crest and ischial tuberosity are united, whereas the proximal epiphysis of the clavicle is still ununited. Also, the symphysis shows the characteristic billowing of this age.

The tooth mutilation exhibited by this young male (Fig. 1, A) consists of six Λ-shaped grooves or notches: two in the occlusal edge of each upper median incisor and one in each upper lateral incisor. The remaining upper teeth and all the lower teeth are not involved. The notches are not very deep but originally may have been deeper because about a millimeter of the occlusal edge has disappeared through attrition.

In most skull measurements no. 5 is above the average of the Jersey County bluff group, and yet well within the group range (57 males). The group as a whole, including this specimen, is rather low in variability. The ratios between the skull measurements, likewise within the group range, are reasonably close to the group averages, as shown by the following figures:

Index	*No. 5*	*Male Average*	*Range*
Cranial	77.7	75.5 (57)	69.6– 81.6
Mean height	89.9	88.5 (55)	82.0– 95.5
Upper facial	52.8	54.2 (55)	46.4– 61.9
Orbital	94.9	87.7 (57)	72.5– 98.6
Nasal	47.2	49.1 (57)	42.4– 56.9
External alv.	130.2	122.5 (46)	110.2–134.0

The fact that no. 5 has a rounder orbit and shorter palate is probably not significant in the sense of a true group difference.

Cahokia isolated tooth.—The single median incisor next to be described (Fig. 1, F, G) was picked up either by P. F. Titterington or by the late M. A. Wurtheimer in October, 1925, on the surface of a village site three-fourths of a mile west of Monk's Mound (Cahokia) in East St. Louis, Ill. When we examined this tooth together in 1943, but before the mutilation in the foregoing specimen was recognized, we did not appreciate its full significance. It was difficult at that time to make the correct interpretation owing to several factors that will be described. Much of the enamel had been lost postmortem, and in addition there had been extensive antemortem wear of the occlusal edge. These alterations in the enamel so changed the appearance of the tooth that we were uncertain whether it was an incisor or canine, human or animal. Moreover, the nature of the markings on the remaining enamel surface also influenced our opinion. These consisted of a transverse groove on the labial surface and four Λ-shaped notches in the occlusal edge (the outermost notches being incomplete now due to loss of enamel). As far as we know, a transverse groove has not been described heretofore in the Western Hemisphere.[4] Thus we were inclined earlier, upon cursory examination, to regard the markings on this tooth as an example of postextractional decoration. This interpretation was dispelled upon subsequent study when we decided that the tooth is really a human upper median incisor and that the markings show a polishing that could have been acquired only during life.

Cahokia compound burial.—In January, 1944, one of us (P. F. T.) acquired some

[4] Dr. Gordon Willey tells us that a skull with a transverse groove on the labial surface of each median incisor was found in a Lamar culture site near Macon, Ga. Efforts to secure this skull for examination have been unsuccessful thus far.

loose human teeth from two men, Joe Walta and Gregory Perino, who in the fall of 1943 had found a compound burial, at a depth of 3 feet, several hundred yards east of Monk's Mound. The skeletal material is said to have been in poor condition and only the better preserved teeth from a few of the skulls were saved. Upon cleaning these teeth notches were observed in three, but no significance was attached thereto by the discoverers. The only recovered cultural object associated with this burial is a small, rough, 3-notched arrowhead.

The three filed teeth—upper median incisors and upper right lateral incisor—were found upon close examination to have large facets of wear resulting from the rubbing together of the teeth at the points of their proximal contact. From the appearance of these facets it was possible to reestablish the original relationships of all three teeth (Fig. 1, D, E), and to demonstrate that they belonged to one individual. In the same way an unfiled right upper canine was found to articulate with the lateral incisor. No other teeth belonging to this individual could be definitely identified. As thus revealed, the mutilation pattern consists of three Λ-shaped notches in the occlusal edge of each upper median incisor and two in each (probably) lateral incisor. The notches are very shallow and involve only the enamel of the labial surface. Wear of the occlusal edge has reached the point of dentin exposure and is irregular owing to a slight malocclusion (rotation of median incisors). These facts suggest that the filing was done after attrition was well under way.

Grindell skull.—The last example of filed teeth, which has come to our attention since the first of the year, was obtained by one of us (P. F. T.) from the collection of J. C. Grindell. In this case the whole skull was recovered and is known to be part of an extended burial, one of some 16, exposed in 1937 by Gregory Perino at the base of a bluff 8 miles south of the Cahokia Mound group. The scanty cultural material found in association with these burials (barrel-shaped shell beads, cord-impressed grit-tempered sherd) are not diagnostic as to period.

The sex of this individual can not be determined with certainty from the skull alone. Supraorbital ridges are almost completely absent, the orbital margins are sharp, and the occiput lacks muscle ridges—all female characters. On the other hand, the lower jaw is well developed and has a square chin, as in a male. The sutures of the vault are still open and the teeth are only moderately worn. This indicates an early adult age period.

The dental mutilation consists of three small Λ-shaped notches in the occlusal edge of each upper medial incisor (Fig. 1, B, C). The other teeth are not involved. Of the three notches on each of the two mutilated teeth, the one farthest to the right is largest and most distinct. As in the preceding cases only the labial surface of the enamel is involved.

An indication of the physical type of this skull may be gained from the following indices derived from the cranial measurements and compared with the Jersey County bluff females:

Index	*Grindell skull*	*Female average*	*Range*
Cranial	79.9	75.9 (52)	69.9– 84.3
Mean height	84.3	88.7 (49)	83.2– 94.7
Upper facial	56.1	55.5 (47)	48.5– 61.4
Orbital	92.1	89.1 (51)	80.0– 98.6
Nasal	46.9	51.0 (53)	43.1– 60.9
External alv.	118.2	118.7 (36)	105.6–132.6

DISCUSSION

The four examples of tooth filing from Illinois here reported, together with the two other cases about which we have indirect knowledge—from Arizona and Georgia—have one thing in common: a late prehistoric age. The specimens from near St. Louis most probably relate to the Middle Mississippi cultural period, "the last phase of the pre-Columbian history of the Mississippi Valley, say roughly the interval between 1400 and 1700 A.D." (Phillips, 1940, p. 365). In general the Cahokia mound site belongs to this period, whereas the Jersey County bluff focus exhibits about equal numbers of Woodland and Middle Mississippi cultural traits (see McKern's allocation in Titterington, 1943). The specimen reported to have been found near

Macon, Ga., is attributed to the Lamar period of which Ford and Willey (1941, p. 351) say: "This was probably well formed and had taken over the southeastern area, submerging the earlier Middle Mississippi culture, by 1600." Similarly, Sikyatki in northern Arizona, while not yet accurately dated, is generally regarded as belonging to the Pueblo IV period, which extended from about 1250 to 1700 (Roberts, 1937).

As already indicated, evidence has been accumulating that certain cultural traits attributed to the Middle Mississippi period seem to have been derived more or less directly from Mexico (Phillips, 1940). Since tooth mutilation is a good Middle American trait, the finding in Illinois of the first specimen described above suggested to one of us (T. D. S.) that here was an actual bearer of this culture. How otherwise than by visiting a place where tooth mutilation was practiced could an Indian in these early times have learned about and had his own teeth filed? From this assumption it seemed logical to conclude that, since this individual was of the same physical type as the Jersey County bluff people among whom he was buried, he must have been a local Indian who had traveled as far south at least as Mexico.

The subsequent finding of three more examples of tooth mutilation nearby changes this picture and indicates the danger in generalizing from insufficient information. It now seems possible that the custom was even more common and perhaps widespread in our country than we have detected. This being the case, we can not say that any one of these individuals bore the custom in his own teeth from Middle America, and it is more unlikely that all had made the trip.

That there can be little doubt as to Mexico or Central America being the source from which our Indians derived the custom is shown by the details of the mutilation. The same pattern of notches as exhibited by the Jersey County bluff specimen (1-2-2-1; or according to Rubín de la Borbolla's classification: A-C-C-A) has been illustrated by Rubín de la Borbolla (1940, pl. 1c), Strebel (1885, pl. 8, no. 18), and Stewart (1941, pl. 1, D) with specimens from Mexico (States of Michoacán and Veracruz) and Honduras, respectively. Quite likely a thorough search of the literature would reveal still other such illustrations, for, judged from descriptions of isolated teeth, this pattern seems to have been used quite frequently.

Teeth with three notches are also well known from Middle America (Rubín de la Borbolla, 1940) but their arrangement in patterns, such as that exhibited by the second Cahokia specimen (2-3-3-2, or C-D-D-C), does not seem to have been described.

The first Cahokia specimen, which is an isolated tooth, and also the reported Lamar specimen (see footnote 4), exhibit pattern elements that appear to be new. In Borbolla's summary of dental mutilations neither four notches in a single tooth nor a transverse groove is mentioned. This may indicate that the custom had already been present in this country long enough to have acquired variations. On the other hand it may mean merely that distance and a new setting had released the original custom from its habitual limitations.

It is hoped that this report will stimulate others in possession of cranial collections from Middle Mississippi sites to look for further examples of this trait.

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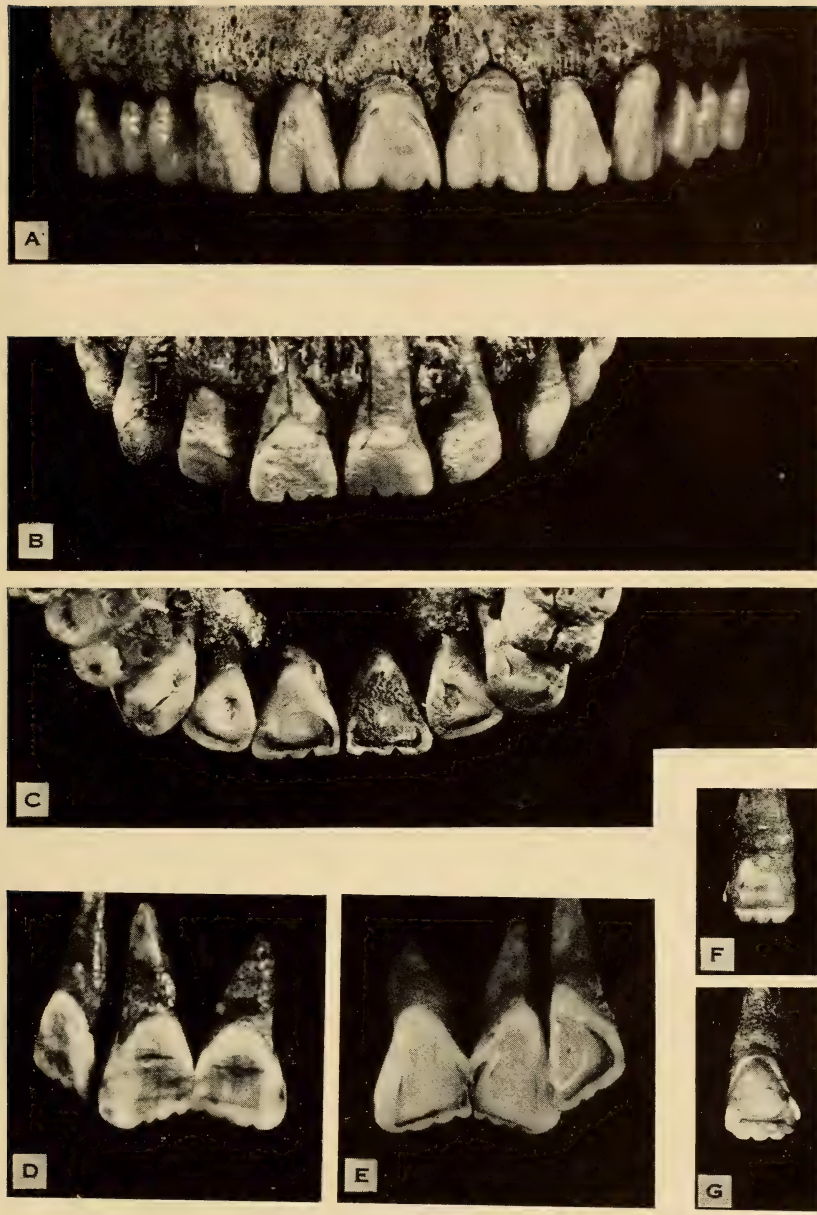

Fig. 1.—Four cases of filed Indian teeth from Illinois: A, Jersey County bluff skull; B and C, Grindell skull; D and E, Cahokia compound burial; F and G, Cahokia isolated tooth. Except for the first specimen, both labial and lingual views are given. Slightly enlarged.

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ANTHROPOLOGY.—*The dental condition of a skull from the Sikyatki site, Arizona.*[1] T. D. Campbell, South Australian Museum. (Communicated by T. D. Stewart.)

The deformed male skull, the teeth of which here are being described, is unique, inasmuch as it is the only known example of artificial tooth mutilation from the southwestern part of the United States. This specimen, from the Pueblo region of Arizona (Sikyatki site), reached the South Australian Museum through exchange with the U. S. National Museum in 1931, and bears the latter's no. 156319.

General.—Upper jaw and mandible intact.

Teeth present: $\dfrac{87654321|1234567.}{87654321|1234567.}$

The upper left third molar appears either to have been lost for some time or never to have erupted (no X-ray confirmation made of this). The lower left third molar has been lost postmortem, the socket being quite apparent.

Many of the teeth in both arches have lost a portion of their crown enamel, which has chipped off postmortem. In the upper first and second molars on both sides, this condition is fairly marked. The three lower right molars also have lost appreciable amounts of their enamel. Upper and lower incisors have been similarly affected.

Caries.—The only teeth present showing any indication of dental caries are $\dfrac{|6}{7|}$ which present very small (pinhead) cavities on the cervical region of their distal enamel surface.

[1] Received August 1, 1944.

Fig. 1.—Anterior view of mandible showing obvious filing on $\overline{21}|$; slight filing on $|\overline{2}$; not apparent on $|\overline{1}$.

Attrition.—Practically all the teeth present, except the third molars, show definite wear of the occlusal surface. Most of them approximate stage II (Broca), that is, show sufficient wear of enamel to expose the cuspal eminences of the dentine. This condition of wear also definitely includes the incisors and cuspids, both upper and lower.

Alveolar process margins.—There appears to have been some minor degree of absorption of the peridental alveolar crest during life; but in places further loss has taken place postmortem.

Filing of teeth.—This artificially made condition involves both upper and lower four incisors. Without other specimens with this form of mutilation for comparison, it is suggested that the filing has not been carried out to any appreciable depth unless attrition has reduced the original effect.

In the case of the upper incisors the filed condition is obliterated to some extent on $\dfrac{21 \mid 1}{\mid}$ by postmortem loss of the labial surface enamel. It is considered so much so that a photograph of these upper teeth would be useless. In general, it may be said that the depth of filing in the form of a small narrow V-shaped notch (formed by labiolingual filing across the incisal edge) on all the incisors is, at the most, not more than 1 mm in depth. The file notches are evident only on the labial and lingual enamel, as the incisal edges have been worn to flat surfaces with exposed dentine showing inside the ring of enamel. This latter point suggests that possibly the filing was done well before adulthood, or before attrition had obliterated the incisal edges of the teeth concerned. If this be so, the V notch was probably much deeper than seen on this specimen. Other examples should confirm this, or otherwise.

The dental condition of this specimen does not present any other features of special interest requiring description for present purposes.

Fig. 1 shows an anterior view of the mandible. Filing is quite obvious on $\overline{21|}$; very slight on $\overline{|2}$; on $\overline{|1}$ not apparent.

BOTANY.—*Descriptions and revisions of several species of viruses in the genera* Marmor, Fractilinea, *and* Galla.[1] H. H. McKinney, Bureau of Plant Industry, Soils, and Agricultural Engineering.

Several species and varieties of viruses infecting cereal and forage grasses are herein described and named. The description of the wheat mosaic-rosette virus is emended. The description of the tobacco ring-spot virus is emended, and the species is transferred to the genus *Marmor* Holmes emend. McKinney (14). The virus inducing mild dark-green mosaic in tobacco is described and named.

The viruses infecting cereal grasses in Russia and Siberia are placed in the genus *Fractilinea* McKinney (14), because they induce chlorotic mottling and streaking reactions that are almost identical with the reactions induced by the grass-mosaic viruses, and they are transmitted by leafhoppers or by planthoppers. It is not entirely clear that the necrosis referred to by some writers in the U.S.S.R. is associated chiefly with the phloem as some writers state that there is necrosis in the parenchyma. The grass mosaics occurring in the U.S.S.R. seem to be sufficiently distinct in their transmission and other characteristics to justify specific ranks in each case.

The wheat-mosaic viruses reported from Japan seem to be very similar to the soil inhabiting wheat-mosaic viruses occurring east of the Mississippi River in the United States, and no attempt is made to separate them at present. The rosette expression has not been positively identified with the viruses occurring in Japan, but it is possible that none of the wheat varieties used in the Japanese tests carry genetic factors for the rosette expression.

The virus inducing the wallaby-ear disease of corn (maize) is placed in the genus *Galla* Holmes as redefined by McKinney (14).

Each virus species is designated as a binomial, and the description embraces only characteristics that are common to all the

[1] Received April 4, 1944.

recognized forms included under it. In all cases in which subdivisions of a species are recognized, the name var. *typicus* is given to the form on which the species was originally based or which is selected as the typical form in case the species as originally described included more than one form. This procedure is in accord with that followed by several students of the flowering plants, including Croizat (1) and Ley (6). The description of the species may require emendation from time to time as new strains and closely related species are described, as it is not possible to foretell what characters may differentiate undiscovered strains. All the strains described are accorded the rank of variety. All these have been isolated with comparative ease from diseased plants growing under field culture conditions. As further study may indicate that some of these strains, or possibly some of the species, should be placed at higher or at lower levels in the scheme, the changes may be made in accordance with the International Rules of Botanical Nomenclature.

Marmor tritici Holmes (2) emend.

Host reactions: In *Triticum aestivum* L. (*T. vulgare* Vill.), *T. compactum* Host, *T. turgidum* L., *T. durum* Desf., *T. spelta* L., *T. timopheevi* Zhuk., *T. dicoccum* Schrank, *T. polonicum* L., *T. monococcum* L., *Hordeum vulgare* L., *Secale cereale* L., and in *Bromus commutatus* Schrad., induces chlorotic streaking and mottling in varying degrees from slight to severe. Optimum experimental conditions for expression of disease reactions near 15.6° C. with a daily photoperiod near 8 hours. Induces vacuolar cell inclusions associated with cells of the epidermis, mesophyll and phloem parenchyma. *Agropyron repens* (L.) Beauv., *Bromus inermis* Leyss., *Avena sativa* L., *A. byzantina* C. Koch, *Zea mays* L., *Nicotiana tabacum* L., *Lycopersicon esculentum* Mill., *Cucumis sativus* L., and *Phaseolus vulgaris* L. are immune or highly resistant.

Transmission: By inoculation with expressed juice, using needle pricks in the bases of small seedlings or by the carborundum-wiping method, but with difficulty. In nature virus overseasons in soil, more especially soils of heavy texture; natural infection in fall-grown winter annuals and in certain fall-sown spring annuals that survive mild winters. Infection rare in spring-sown suscepts and in winter wheats that emerge in spring when sown very late in autumn.

Insect vector not known, but some soil inhabiting vector is suspected, as no infection has occurred in plants grown in sterilized soil to which was added ample quantities of virus-infested plant tissue. Wheat plants grown in sterilized soil in containers located in infested areas during the entire natural growing season have never developed mosaic.

Mutation: Mutation has not been proved, but it is suspected. However, it appears that interference (antagonism) between the type virus and its presumed strains is of a low order as the strains have been isolated by methods that would fail to isolate the mutants of other viruses that manifest a high degree of unilateral interference.

Physical properties: Inactivated in 6 to 14 days at room temperatures in leaf tissue collected fresh, clipped in short pieces and allowed to dry. Heavily infested soil was rendered noninfectious when drenched with a solution of 1 part formalin in 49 parts of water, also when heated in a moist condition for 10 minutes at temperatures near 60° C. and above; when diluted with 31 parts of noninfectious soil, infection in wheat was reduced from 98 percent in the control to 5.3 percent.

Marmor tritici var. typicum, var. nov.

Wheat virus 1 McKinney (10); Triticum virus 1 Smith (20); *Marmor tritici* Holmes (2).

Common name: Wheat mosaic-rosette virus.

Host reactions: In *Triticum aestivum* var. Harvest Queen and a few other varieties of winter wheat, virus induces mild green mosaic, bud proliferation, rosetting, and dwarfing; in most varieties of *T. aestivum* and in other suscepts, induces mosaic ranging from mild green to severe yellow types.

It has not been possible to maintain this virus indefinitely in manually inoculated wheat plants cultured under apparently optimum conditions in chambers. The infection rate has gradually decreased until none obtained, and it became necessary to make new isolations from time to time from naturally infected plants in the field.

Distribution: Illinois, Indiana, Maryland, Virginia, North Carolina; possibly Japan.

Marmor tritici var. fulvum, var. nov.

Wheat virus 3 McKinney (10).

Common name: Prairie wheat yellow-mosaic virus.

Varietal name from L., *fulvus,* deep yellow.

Host reactions: In *Triticum aestivum* var. Harvest Queen and in other suscepts, induces yellowish-green to yellow mosaic; severe stunting, leaf rolling, and death in highly susceptible hosts, but no systemic necrosis or rosette.

It has not been possible to maintain this virus indefinitely in manually inoculated wheat plants cultured under apparently optimum conditions in chambers. The infection rate has gradually decreased until none obtained, and it became necessary to make new isolations from time to time from plants infected in the field.

Distribution: Illinois, Indiana, Maryland, Virginia, North Carolina; possibly Japan.

References to literature: (2, 3, 4, 8, 9, 10, 15, 20, 28, 29, 30, 31, 32).

Marmor campestre, sp. nov.

Specific name from Latin, *campester,* adj., dwelling on open plains.

Host reactions: In *Triticum aestivum* L., *T. spelta* L., *T. timopheevi* Zhuk., and in *Hordeum vulgare* L., induces chlorotic mottling and streaking; no proliferation or rosetting. Optimum conditions for expression of disease reactions near 15.6° C. with a daily photoperiod near 8 hours, induces vesicular cell inclusions. *Avena sativa* L., *Bromus inermis* Leyss., *Agropyron repens* (L.) Beauv., *Zea mays* L., *Nicotiana tabacum* L., *Lycopersicon esculentum* Mill., *Cucumis sativus* L., and *Phaseolus vulgaris* L., are immune or highly resistant.

Transmission: By inoculation with expressed juice, using needle pricks in the bases of small seedlings or by the carborundum-wiping method, but with difficulty; overseasoning in soil not known; no insect vectors known.

Mutation: Mutation has not been proved, but it is suspected. However, it appears that interference (antagonism) between the type virus and its presumed strains is of a low order as the strains have been isolated by methods that would fail to isolate the mutants of other viruses that manifest a high degree of interference.

Physical properties: Inactivated in about 7 months in leaf tissue at temperatures near −17° C.

Marmor campestre var. typicum, var. nov.

Wheat virus 4 McKinney (10).

Common name: Plain's wheat green-mosaic virus.

Host reactions: In *Triticum aestivum* vars. Harvest Queen and Turkey, induces light-green mosaic and stunting.

It has not been possible to maintain this virus indefinitely in manually inoculated wheat plants cultured under apparently optimum conditions in chambers. The infection rate has gradually decreased until no infection occurred, and it became necessary to make new isolations from time to time from plants infected in the field.

Distribution: Riley County, Kansas.

Marmor campestre var. galbinum, var. nov.

Wheat virus 5 McKinney (10).

Common name: Plain's wheat yellow-mosaic virus.

Varietal name from Latin, *galbinus,* adj., yellowish green, yellowish.

Host reactions: In *Triticum aestivum* vars. Harvest Queen and Turkey, induces severe yellow mosaic, sometimes yellow streaking, stunting, and sometimes killing.

This virus has been maintained in manually inoculated plants without difficulty under optimum conditions, but not under the high-temperature conditions obtaining during the summer period.

Distribution: Riley County, Kansas.

Reference to literature: (10).

Marmor virgatum, sp. nov.

Specific name from Latin, *virgatus,* adj., striped.

Host reactions: In *Triticum aestivum* L., *T. timopheevi* Zhuk., *T. turgidum* L., *T. durum* Desf., *T. spelta* L., *T. dicoccum* Schrank, *T. polonicum* L., *T. monococcum* L., *Hordeum vulgare* L., *Avena byzantina* C. Koch, *A. sativa* L., *A. sativa* var. *orientalis* (Schreb.) Alef., *A. brevis* Roth, *A. strigosa* Schreb., and *Zea mays* L., induces chlorotic mottling and streaking (con-

tinuous and broken); dwarfing of plant, but not necrosis, proliferation, or rosetting; induces vesicular cell inclusions. Disease reactions expressed over a relatively wide range of temperatures, from 15.6° C. to summer temperatures, apparently depending largely on the optimum requirements for the hosts. In *Zea mays* var. Golden Giant sugar, the incubation period ranges from 6 to 22 days; infection has not occurred in more than 50 percent of the seedlings when the best known methods were used, i.e., young seedlings inoculated before the third leaf exceeds 2.5 cm in length, with fresh virus obtained from young infected wheat leaves.

Agropyron repens (L.) Beauv., *Poa pratensis* L., *P. compressa* L., *Bromus inermis* Leyss., *Secale cereale* L., *Nicotiana tabacum* L., *Cucumis sativus* L., and *Phaseolus vulgaris* L., are either immune or very resistant.

Transmission: By incoulation with expressed juice, readily in most hosts by wiping carborundum dusted leaves of young seedlings, but difficult in *Zea mays;* overseasoning in soil null; insect vectors not known.

Physical properties: Inactivated in plant juice near 55° C. in 10 minutes; after about 7 months in tissue frozen near −17° C. in dry tissue after 34 to 40 days at room temperature; dilution-end-point near 5,000 ×.

Marmor virgatum var. typicum, var. nov.

Wheat virus 7 McKinney (10).

Common name: Wheat yellow streak-mosaic.

Host reaction: In *Triticum aestivum* var. Harvest Queen and Turkey, induces yellow streaks, continuous or broken; especially severe in Victoria and White Tartar varieties of oats, and in Hard Federation and Kawvale varieties of wheat. Seems to be the predominating type in wheatfields infested with this species. This virus has been maintained in manually inoculated wheat plants cultured over a wide range of conditions.

Distribution: Saline and Riley Counties, Kansas.

Marmor virgatum var. viride, var. nov.

Wheat virus 6 McKinney (10).

Common name: Wheat green streak-mosaic virus.

Varietal name from Latin, *viridis*, green.

Host reactions: In *Triticum aestivum* var. Harvest Queen and Turkey, induces light-green streaks, continuous or broken, and wide longitudinal bands; in Kawvale wheat symptoms are similar to those induced by var. *typicum*, therefore, this wheat is not a good differential host for the two viruses. In *Zea mays* var. Golden Giant sugar, the reactions are practically indistinguishable from those induced by var. *typicum.* The virus has been maintained in manually inoculated wheat plants cultured over a wide range of conditions.

Distribution: Saline and Riley Counties, Kansas.

Reference to literature: (10).

Marmor graminis, sp. nov.

Common name: Brome-mosaic virus.

Host reactions: In *Bromus inermis* Leyss., *Triticum aestivum* L., *Hordeum vulgare* L., *Secale cereale* L., *Avena sativa* L., var. *orientalis* Schreb., *A. byzantina* C. Koch, *Sorghum vulgare* Pers., *Euchlaena mexicana* Schrad., *E. perennis* Hitchc., *Zea mays* L., induces light-green to yellow mottling and streaking; no bud proliferation or rosetting. In *Euchlaena mexicana*, certain collections of *E. perennis*, and in *Zea mays*, induces local and systemic necrosis and death. In *Zea mays* var. Golden Giant sugar, the incubation period is from 36 to 40 hours for local lesions, and from 52 to 70 hours for systemic symptoms at high summer temperatures in the greenhouse. All seedlings become infected and die within a few days when inoculation is done by the best known methods. Increase of natural resistance with the aging of the corn plants is very marked. *Buchloë dactyloides* (Nutt.) Engelm., *Eragrostis curvula* (Schrad.) Nees., *E. trichodes* (Nutt.) Nash, and *Oryzopsis hymenoides* (Roem. and Schult.) Ricker, are "symptomless" carriers at temperatures near 21° C. during the winter. In *Phaseolus vulgaris* L., var. Scotia, virus induces small inconspicuous brown local lesions; in *Cucumis sativus* L., var. Early White Spine, and in *Nicotiana tabacum* L., var. Samsun(Turkish), induces local faintly chlorotic spots on the wiped cotyledons and leaves respectively, and there is a marked increase of virus in each host. This virus has a wide host range, especially among the grasses, and it is easily maintained in pure culture over a wide range of conditions.

Saccharum officinarum L., var. Louisiana

Purple, *Oryza sativa* L., and *Phaseolus lunatus* L., vars. Henderson Bush lima and Jackson Wonder lima are either immune or highly resistant.

Cellular pathology apparently unlike that induced by other viruses studied in cereal hosts. In unstained, living epidermal cells the inclusions are irregularly shaped, transparent, or translucent masses, usually located in the ends of the cells.

Transmission: By inoculation with expressed juice from diseased plants, readily by wiping on carborundum-dusted leaves of small seedlings; difficult in older plants.

Physical properties: Inactivated in 10 minutes at temperatures between 79 and 80° C. in juice from infected corn seedlings, after 12 months in dry leaves of *Bromus inermis* at room temperature; after 14 months at temperatures near −17° C. in juice from *B. inermis*. Dilution-end-point as high as 100,000 to 300,000 ×, using juice from *B. inermis* and diluting with distilled water.

Distribution: Manhattan, Kansas.

Reference to literature: (13).

Marmor agropyri, sp. nov.

Host reactions: In *Agropyron repens* (L.) Beauv. and in *Triticum aestivum* L., induces chlorotic mottling; no bud proliferation or rosetting. Optimum experimental conditions for expression of disease reactions near 15.6° C. with a daily photoperiod near 8 hours. Induces granular cell inclusions in epidermal cells occasionally.

Transmission: By inoculation with expressed juice, using needle pricks in bases of small seedlings or by the carborundum-wiping method, but with difficulty. Virus overwinters in the rhizomes.

Mutation: Suspected, but interference seems to be of a low order, if it occurs.

Marmor agropyri var. typicum, var. nov.

Wheat virus 2 McKinney (10).

Common name: Agropyron green-mosaic virus.

Host reactions: In *Agropyron repens* and *Triticum aestivum* var. Harvest Queen, induces mild-green mosaic that is masked during the summer.

Distribution: Arlington County, Virginia.

Marmor agropyri var. flavum, var. nov.

Common name: Agropyron yellow-mosaic virus.

Varietal name Latin, *flavus*, golden-yellow.

Host reactions: In *Agropyron repens* and *Triticum aestivum* var. Harvest Queen, induces yellow mosaic that is very mild during the summer, but not masked.

Distribution: Arlington County, Virginia. Coincident with var. *typicum*, but in separate colonies of the host.

Reference to literature: (10).

Marmor constans, sp. nov.

Tobacco virus 12 Johnson (5); Nicotiana virus 6 Smith (20).

Common Name: Tobacco mild dark-green mosaic virus.

Specific name from Latin, *constans*, adj., fixed, referring to the relatively stable nature of the virus with regard to mutation.

Host reactions: In *Nicotiana tabacum* L., var. Turkish (Samsun) and other commercial varieties of tobacco, induces chlorotic-mosaic mottling that tends towards a very coarse pattern; in *N. glauca* R. Grah. (Canary Isl. Col.) pronounced chlorotic mosaic mottling. In *N. glutinosa* L., *N. rustica* L., *N. sylvestris* Spegaz. Comes induces local necrotic lesions when cultured near 22° C. In *Phaseolus vulgaris* L. var. Scotia, induces small inconspicuous local necrotic lesions when cultured near 33.3° C. In certain collections of *N. tabacum* from Colombia (derivatives from Ambalema and T.I. 448A), induces only occasional chlorotic spots or no visible reactions, this resistance coinciding with that against *Marmor tabaci* (Holmes ex Valleau) McKinney. *Lycopersicon esculentum* Mill., and *Cucumis sativus* L. are immune. Interference (antagonism) between *M. constans* and *M. tabaci* ranges from very low or none to moderate, depending on the host and culture conditions.

Transmission: Readily by inoculation with expressed juice; insect vectors not known.

Mutation: No positive mutation has been observed in the hundreds of infected plants studied in the greenhouse, but isolates from *N. glauca* growing in the Canary Islands revealed what appears to be a closely related yellow type.

Physical and chemical properties: Inactivated

near 86° C. in 10 minutes in plant juices; activity not lost completely after 12 years' storage of dry tissue at room temperatures; dilution end point near 100,000 ×; the unit paracrystals of the virus protein at pH 4.5, measure 1.0 to 1.6μ in length and 0.4 to 0.5μ in width, being about one-fourth to one-half the length of those of *Marmor tabaci* in comparative tests.

Distribution: Islands of Grand Canary and Teneriffe.

References to literature: (5, 7, 11, 17, 20, 27).

Marmor anularium, nom. nov.

Tobacco virus 10 Johnson (5); Nicotiana virus 12 Smith (20); *Annulus tabaci* var. *Virginiensis* Holmes (2).

Common name: Tobacco ring-spot virus.

Specific name from Latin, *anularius*, adj., ringlike, referring to the ring spots induced in certain hosts.

Host reactions: In *Nicotiana tabacum* L., a moderately resistant host, induces acute and chronic reactions that are unusually distinct, especially when infection obtains in the young plants. In the acute phase, the virus induces primary and secondary necrotic lesions and chlorotic ring spots, and sometimes secondary chlorotic-line or oak-leaf patterns. In the chronic phase, the virus induces no striking reactions at 20° C., and above, but when culture temperatures are near 16° C., certain tobacco varieties, especially Burley types and certain collections from Colombia, i.e., Ambalema and T.I. 448, manifest mosaic patterns in the young leaves. In *Cucumis sativus* L., var. Early White Spine, a very susceptible host, the virus induces primary necrotic and chlorotic spots, secondary chlorotic spots, and typical mosaic mottling which usually persists throughout the summer growing season. In *Phaseolus vulgaris* L., especially at high temperatures (33.3° C.), induces local necrotic lesions, systemic necrosis and death. This species has a very wide host range including many legumes.

Transmission: By inoculation with expressed juice, readily by wiping carborundum-dusted leaves of thrifty plants with concentrated fresh virus; through a portion of the seeds from diseased tobacco and petunia plants. Insect vectors not known.

Physical and chemical properties: Inactivated near 68° C. in 10 minutes in plant juice; after 3 to 4 days in plant juice at room temperatures; after several months near or below freezing. Does not withstand drying in leaves at room temperature. Dilution end point in plant juice between 1,000 and 10,000 ×; minimal diameter of particles about 15 mμ, passes the fine (W) Berkefeld filter. Regarded as a high molecular-weight protein.

Distribution: Commercial tobacco-growing areas in the United States, especially in the Eastern States.

References to literature: (2, 5, 12, 20).

Fractilinea tritici, sp. nov.

Common name: Russian wheat-mosaic virus.

Host reactions: In *Triticum aestivum* L. (winter and spring varieties), *Avena sativa* L., *A. byzantina* C. Koch, *A. fatua* L., *Hordeum vulgare* L., *Secale cereale* L., induces light-green or yellow mottling or streaking in foliage, proliferation of stalks in some winter wheats (rosette), dwarfing of plants, little or no proliferation in the spring-grown species, great reduction in grain, death frequently in young plants, necrosis of phloem, vacuolar cell inclusions, needle-shaped protein "crystals" in cells when leaf sections are placed in an acid medium.

Transmission: By the leafhopper *Deltocephalus striatus* L. Attempts to transmit the virus by means of the planthopper *Delphacodes striatella* Fall. (*Delphax striatella*), many other insects, and by inoculations with expressed juice met with failure. Attempts to obtain infection through the soil have met with failure.

Distribution: Russia, east of the Ural Mountains, especially in the Voronezh district since about 1935; to some extent near Moscow and south to the Caucasus Mountains.

References to literature: (18, 21, 33, 34, 35, 36, 37).

Fractilinea avenae, sp. nov.

Common name: Siberian oat-mosaic virus (zakooklivanie).

Host reactions: In *Avena sativa* L., *A. strigosa* Schreb., *A. byzantina* C. Koch, *A. fatua* L., and *A. sterilis* L., induces light-green to yellow mottling and streaking in foliage and leaf sheaths; in certain species and varieties of *Avena* induces dwarfing, excessive tillering (rosette), floral deformations, sterility, great

reduction in grain, vacuolar cell inclusions resembling those in *Marmor tritici* var. *typicum*, necrosis of phloem and parenchyma in cases of severe mosaic reaction, vacuolar cell inclusions, giant protein inclusions, "crystals" and fibers. Infection occurs in *Zea mays* L., *Hordeum vulgare* L., *Secale cereale* L., *Panicum miliaceum* L., *Oryza sativa* L., and is suspected in *Triticum aestivum* L., and *Bromus* sp. A few individuals of *Calamagrostis epigeios* (L.) Roth, found susceptible, but the species seems to be very resistant. The virus was found to overwinter in *Agropyron repens* (L.) Beauv., *Bromus inermis* Leyss., *Echinochloa crusgalli* (L.) Beauv. and *Setaria viridis* (L.) Beauv., but in the first three species there seems to be very high resistance, and a small virus reservoir. *Setaria viridis* is very susceptible, highly attractive to the vector and an important reservoir for the virus.

Transmission: By the planthopper *Delphacodes striatella* Fall. (*Delphax striatella*). Attempts to transmit the virus by means of the leafhopper *Deltocephalus striatus* L. and by inoculations with expressed juice have met with failure. Attempts to obtain infection through the soil have also met with failure, though early observers postulated the overseasoning of the virus in the soil.

Distribution: Over most of Siberia from the Ural Mountains, to the Pacific coast, but more especially in the vicinity of Omsk, since 1922. In Japan the virus of rice-stripe disease is also transmitted by *Delphacodes striatella,* thus suggesting that the two diseases may be caused by similar or identical viruses.

References to literature: (16, 22, 23, 24, 25, 26).

Galla zeae, sp. nov.

Common name: Wallaby-ear disease of corn (maize).

Host reactions: In *Zea mays* L., induces, in young plants, small swellings on secondary veins on undersides of top leaves, suggesting the galls associated with the Fiji disease of sugarcane, veins swelling rapidly from the tip to base of the leaf blade; inward rolling of leaves as in drought; green color accentuated, dwarfing of plant and all of its organs. Older plants give mild reactions.

Transmission: By the leafhopper *Cicadula bimaculata* Evans.

Distribution: Southeastern Queensland, Australia.

Reference to literature: (19).

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BOTANY.—*Additional records of aquatic Phycomycetes isolated from Mexican soils.*
LELAND SHANOR, University of Illinois.[1] (Communicated by W. W. DIEHL.)

A relatively small number of aquatic Phycomycetes have been collected in Mexico. Wolf (1939) reported eight species which are distributed among three orders, the Blastocladiales, the Saprolegniales, and the Leptomitales. Stüben (1939) obtained a blastocladiaceous species, described as *Sphaerocladia variabilis*, from Mexican soil. Couch and Whiffen (1942) have transferred *Sphaerocladia variabilis* to the genus *Blastocladiella*, renaming it *Blastocladiella stübenii*. Nabel (1939) obtained from Mexico the interesting phycomycete *Rhizidiomyces bivellatus*, a species belonging in the order Anisochytridiales (Karling, 1943). The author (Shanor, 1942) discovered and described *Monoblepharella mexicana*, this being the first representative of the order Monoblepharidales to be reported from this area. Therefore, to date, five orders of the aquatic Phycomycetes are represented among the fungi that have been collected in Mexico.

It is the purpose of the present paper to record other aquatic Phycomycetes that have been isolated from Mexican soils, adding representatives of two more orders. The large and widely distributed order Chytridiales is not represented by any species previously reported. The most numerous isolates encountered in the present study belong to this group.

The majority of the soil samples from which the fungi to be reported here were isolated were generously procured for me during the summer of 1941 by William C. and Mrs. Martha M. Leavenworth, members of the Fourth Hoogstraal Biological Expedition to Mexico. The manner in which these samples were collected and subsequently handled was described briefly in the introductory remarks to my previous paper.

Through the courtesy of Prof. H. J. Fuller, additional samples were collected during February, 1942, and made available for my study. These samples were taken from moist soil, allowed to dry, and then placed in carefully sealed envelopes and later mailed to the Botanical Laboratory of the University of Illinois, where they were put in jars to which were added sterilized distilled water and suitable substrata for growth of aquatic Phycomycetes. As fungal growth appeared on these materials, individual species were isolated from them for more careful study.

With very few exceptions all the samples collected by the Leavenworths were taken at high altitudes and from soil rich in humus. The samples obtained by Professor Fuller were from much lower altitudes and were mostly from somewhat sandy or from clay soils. All isolates belonging to the rather widely distributed genus *Allomyces* obtained in the present study were secured from the samples taken at the lower altitudes. Isolates of *Allomyces* were obtained much more frequently than species of other genera from the Mexican soil samples collected and studied by Wolf (1939).

The following résumé of species found includes collection data submitted with the soil samples from which isolates were obtained. Additional distributional data pertaining to the species recorded here are to be found in recently published works by Coker and Matthews (1937), Middleton (1943), and Sparrow (1943).

Order CHYTRIDIALES

Family RHIZIDIACEAE

Rhizophlyctis rosea (deBary and Woronin) Fischer

Rabenhorst Kryptogamen—Fl. 1 (4): 122. 1892.

(1) From mud taken on north side of Mount Tancitaro at elevation of about 11,000 feet; July 23, 1941. Leavenworth and Leavenworth.

(2) From mud and humus from wet meadow on north side of Mount Tancitaro at elevation of about 10,000 feet; July 24, 1941. Leavenworth and Leavenworth.

(3) From clay soil taken from meadow near Monterrey; February 5, 1942. Fuller.

(4) From clay soil taken at Córdoba, Veracruz; February 20, 1942. Fuller.

(5) From mud taken from forest near Taxco; February 22, 1942. Fuller.

This species was isolated more frequently than any other chytrid. Vigorous growth was

[1] Received May 29, 1944.

obtained on pieces of corn-seedling leaves, grass leaves, and on cellophane bait. Resting spores were formed abundantly on the pieces of corn-seedling leaves and on cellophane and were similar to those described by Ward (1939). No attempt was made to demonstrate in these isolates the heterothallic nature of this species as reported by Couch (1939).

Rhizophlyctis petersenii Sparrow

Proc. Amer. Phil. Soc. **78** (1): 48. 1937.

(1) From mud and humus from wet meadow along stream north side of Mount Tancitaro at elevation of 10,000 feet; July 24, 1941. Leavenworth and Leavenworth.

(2) From clay soil from Córdoba, Veracruz; February 24, 1942. Fuller.

The sporangia of these isolates varied considerably in size. The long exit tube and the behavior of spores upon emergence are distinctive characteristics of the species. Resting spores have been observed several times which were similar to those described by Sparrow (1937).

Family CHYTRIDIACEAE

Cylindrochytridium johnstonii Karling

Bull. Torrey Bot. Club **68**: 382. 1942.

(1) From mud from a wet meadow along north side of Mount Tancitaro at an elevation of 10,000 feet; July 24, 1941. Leavenworth and Leavenworth.

This fungus was isolated only once. It produced sporangial thalli abundantly on corn-seedling leaves and on pieces of lens paper and on filter paper. Resting bodies were found in considerable numbers on a small piece of brown paper in the original sample, and a few formed after a long time on pieces of filter paper used as a substratum. These were nearly spherical, with thick, smooth, light-brown or amber-colored walls, and each possessed one large yellowish oil globule when mature.

I have also isolated this species on seed coats of hemp seed placed in water samples from central Illinois. In view of the recent data published by Karling (1942), it appears that this handsome chytrid is rather widely distributed in southeastern and central United States.

Endochytrium operculatum (deWild.) Karling

Amer. Journ. Bot. **24**: 353. 1937.

(1) Mud from stream north side of Mount Tancitaro at elevation of 10,000 feet; July 24, 1941. Leavenworth and Leavenworth.

(2) Soil from La Majada; August 6, 1941. Leavenworth and Leavenworth.

Sporangia and resting bodies were produced abundantly on filter paper and on corn-seedling leaves.

Family MEGACHYTRIACEAE

Nowakowskiella elegans (Nowak.) Schroeter

Eng. and Prantl. Naturlichen Pflanzenfam. **1** (1): 82. 1892.

(1) Mud from wet meadow along a stream on north side of Mount Tancitaro at an elevation of 11,000 feet; July 24, 1941. Leavenworth and Leavenworth.

(2) Soil from La Majada; August 8, 1941. Leavenworth and Leavenworth.

(3) Soil from meadow near Monterrey; February 5, 1942. Fuller.

(4) Clay soil from near Veracruz; February 20, 1942. Fuller.

Although sporangia were produced abundantly on cellophane, lens paper, filter paper, hemp seed, and corn-seedling leaves, I was unable to obtain resting bodies from any of these isolations.

Nowakowskiella hemisphaerospora Shanor

Amer. Journ. Bot. **29**: 174. 1942.

(1) In leaf tissue included with soil from wet meadow, north side of Mount Tancitaro, elevation 10,000 feet. Leavenworth and Leavenworth.

Although I have not obtained isolations of this fungus from any of the samples collected, it is being included provisionally in this list of Mexican aquatic fungi on the basis of resting bodies observed in the tissue of some partially decomposed leaf. The resting bodies of this species are so distinctive that they are not likely to be confused with resting bodies of any similar known species.

Karling (1942) reports obtaining this chytrid from a number of localities in southeastern and south-central United States.

Family CLADOCHYTRIACEAE

Cladochytrium replicatum Karling

Amer. Journ. Bot. **18**: 538. 1931.

(1) From soil and humus from near Veracruz; February 20, 1942. Fuller.

This single isolation produced sporangia abundantly, but resting bodies were rarely found and all observed were of the smooth-walled type.

Cladochytrium hyalinum Berdan

Amer. Journ. Bot. 28: 425. 1941.

(1) Wet meadow along side of stream, north side of Mount Tancitaro at an elevation of 10,000 feet; July 24, 1941. Leavenworth and Leavenworth.

The single isolation was obtained on cellophane and on pieces of boiled corn leaves. Resting bodies were not produced in any abundance by this isolate.

Order BLASTOCLADIALES

Family BLASTOCLADIACEAE

Allomyces javanicus Kniep

Berichte Deutsch. Bot. Ges. 47: 211. 1929.

(1) Meadow near Monterrey; February 5, 1942. Fuller.

(2) Soil from forest near Taxco; February 22, 1942. Fuller.

In both of these isolations gametophyte plants appeared only rarely among sporophytes and were not seen at all until after several months' study and after several attempts to obtain them from resistant sporangia that had been allowed to become dry had proved unsuccessful. Male gametangia were more numerous than female gametangia and were found in some cases along main branches on which resistant sporangia were formed. These two isolates should probably be assigned to var. *perandrus* of Emerson (1941).

Allomyces anomalus Emerson

Lloydia 4: 133. 1941.

(1) Soil from near Veracruz; Feburary 20, 1942. Fuller.

During a period of over six months while this isolate had been under observation, I was unable to obtain gametophytes or cyst formation so am provisionally assigning it to this species proposed by Emerson to include isolates in which sexual reproduction is apparently lacking.

Order MONOBLEPHARIDALES

Family MONOBLEPHARIDACEAE

Monoblepharella mexicana Shanor

Mycologia 34: 242. 1942.

(1) Soil from wet meadow along stream on north side of Mount Tancitaro at an elevation of 10,000 feet; July 24, 1941. Leavenworth and Leavenworth.

(2) Soil from forest near Taxco. February 22, 1942. Fuller.

This very interesting fungus was first described in considerable detail from the isolates obtained from the Mount Tancitaro samples. The isolate from Taxco agrees in all major aspects with those obtained from the type locality.

Order SAPROLEGNIALES

Family SAPROLEGNIACEAE

Achlya flagellata Coker

The Saprolegniaceae: 116. 1923.

(1) Soil from wet meadow along stream on north side of Mount Tancitaro at an elevation of 11,000 feet; July 23, 1941. Leavenworth and Leavenworth.

This isolate did not appear on hemp seed that was placed in the battery jar until several months after the soil sample was put into the jar and flooded with sterilized distilled water.

Order PERONOSPORALES

Family PYTHIACEAE

Pythium debaryanum Hesse

Inaugr. Dissert. Halle. 1894.

(1) Soil from La Majada; August 8, 1941. Leavenworth and Leavenworth.

This isolate was found to be highly pathogenic to the following seedlings planted in flats of sterilized soil into which it was introduced: garden peas (*Pisum sativum* L.), watermelon (*Citrullus vulgaris* Schrad.), cucumber (*Cucumis sativus* L.), spinach (*Spinacia oleracea* L.), tomato (*Lycopersicon esculentum* Mill.), beet (*Beta vulgaris* L.), and radish (*Raphanus sativus* L.).

Pythium graminicolum Subramaniam

Agr. Res. Inst. Pusa Bull. 177: 1–5. 1928.

(1) From soil from meadow near Monterrey; February 5, 1942. Fuller.

This is a widely distributed species both in the Eastern and Western Hemispheres. During the present study it was isolated on hemp seed and on pieces of corn-seedling leaves.

SUMMARY

Fourteen species of aquatic Phycomycetes are reported that were obtained from Mexican soil samples. They are distributed as follows:

Chytridiales—*Rhizophlyctis rosea, R. petersenii, Cylindrochytridium johnstonii, Endochytrium operculatum, Nowakowskiella elegans, N. hemisphaerospora, Cladochytrium replicatum,* and *C. hyalinum.*

Blastocladiales—*Allomyces javanicus* and *A. anomalus.*

Monoblepharidales—*Monoblepharella mexicana.*

Saprolegniales—*Achlya flagellata.*

Peronosporales—*Pythium debaryanum* and *P. graminicolum.*

With the exception of the two species of *Allomyces* and of *Monoblepharella mexicana,* none of these species appears to have been reported previously from Mexico.

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ENTOMOLOGY —*Descriptions of nine species of* Aleuroplatus *from eastern North America* (Homoptera: Aleyrodidae).[1]

Louise M. Russell, Bureau of Entomology and Plant Quarantine. (Communicated by C. F. W. Muesebeck.)

The species of *Aleuroplatus* Quaintance and Baker treated here form a well-defined group and are closely allied. Owing to their structural similarity and to the difficulty of obtaining microscopic preparations satisfactory for critical study, the species frequently have been confused with one another. The pupae, the stage on which this study is based, usually can be more successfully mounted when recently emerged than after they are mature and have become black, brittle, and covered with wax. This group of whiteflies appears to be of actual or potential economic importance, for several species occur on plants of commercial value, and one is suspected of being a vector of the blueberry stunt virus disease.

[1] Received May 26, 1944.

Types of the species discussed are in the collection of the United States National Museum.

Botanists of the Division of Plant Exploration and Introduction, Bureau of Plant Industry, Soils, and Agricultural Engineering, United States Department of Agriculture, kindly identified several plants and checked the names of the hosts.

The following combination of characters distinguishes these species from other members of *Aleuroplatus:* Marginal teeth moderately rounded, slightly wider than long; submarginal disk pores (for terminology see Russell, Proc. Ent. Soc. Washington **45**: [131]–132, 1943) in a single row less than five times the width of a marginal tooth from marginal teeth; without conspicuous

sculpturing along median molting suture; dorsal minute spinelike points absent; transverse molting suture terminating nearly opposite its midpoint, disk pores not in a row posterior to its distal portions; submedian meso- and metathoracic setae shorter than segment bearing them, or absent; cephalic setae present, shorter than metathorax; eighth abdominal setae located just laterocephalad of vasiform orifice; vasiform orifice not largely covered by a transparent membrane; minute spines on ventral surface, in a band paralleling body margin.

The species may be separated by the following key:

1. Submedian mesothoracic and metathoracic setae present 2
   Submedian mesothoracic and metathoracic setae absent 6
2. Vasiform orifice with a well-defined tongue, bottom of orifice extending just anterior to posterior margin of operculum; eye spots inconspicuous, slightly lighter than adjacent derm, not elevated 3
   Vasiform orifice without a well-defined tongue, if with a tooth then bottom of orifice extending nearly to anterior margin of operculum; eye spots conspicuous, much lighter than adjacent derm, elevated 5
3. Vasiform orifice nearly as wide as long, approximately its length from body margin; caudal setae nearer to submarginal teeth than to orifice; central subdorsal disk pores usually absent from abdominal segments 4–7 . . . . *myricae* Quaintance and Baker
   Vasiform orifice distinctly longer than wide and less than its length from body margin; caudal setae nearer to orifice than to submarginal teeth; central subdorsal disk pores usually present on abdominal segments 4 and 5 and sometimes on 6 and 7 4
4. Sides of vasiform orifice opposite operculum of nearly uniform thickness and sclerotization, nearly vertical from bottom to rim, slightly removed from operculum, a curved tongue arising from bottom of orifice about midway between operculum and end of orifice (fig. 3); abdominal minute setal bases usually near central subdorsal disk pores; posterior end of body noticeably broader than anterior end . . . . *plumosus* (Quaintance)
   Sides of vasiform orifice opposite operculum somewhat thickened and heavily sclerotized on lower portion, forming a vertical wall close to the operculum, the wall abruptly interrupted posteriorly and a spatulate tongue in interval between its ends, membrane sloping from wall to rim (fig. 4); abdominal minute setal bases usually near inner subdorsal disk pores except on segment 3; posterior end of body nearly as narrow as anterior end . . . . *semiplumosus*, n.sp.
5. Vasiform orifice without a tooth, its sides slightly convex laterally and strongly so posteriorly, membrane extending from edge of convex portion to posteriorly projecting rim, bottom of orifice extending just anterior to posterior margin of operculum (fig. 6); dorsal abdominal disk pores rather numerous, 7–9 pairs on each of segments 3 and 4, usually 3 submedian pairs on each of segments 1 and 3–6; body slightly constricted at posterior third . . . . . . *magnoliae*, n. sp.
   Vasiform orifice with a tooth, its sides convex opposite operculum but nearly vertical posteriorly, membrane extending from bottom to vertical rim, bottom of orifice extending nearly to anterior margin of operculum (fig. 7); dorsal abdominal disk pores less numerous, 2 or 3 pairs on each of segments 3 and 4, 1 submedian pair on each of segments 1–6; body rather strongly constricted at posterior third . . . . *ilicis*, n. sp.
6. Dorsal abdominal disk pores fairly numerous, 1 submedian pair on each of segments 1–6, and a total of 2–4 pairs on each of segments 3 and 4; body constricted at posterior third; eye spots at least moderately conspicuous . . 7
   Dorsal abdominal disk pores more numerous, 1 or 2 submedian pairs on each of segments 1–6, but a total of 5–13 pairs on each of segments 3 and 4; body not constricted at posterior third; eye spots inconspicuous 8
7. Bottom of vasiform orifice reaching nearly as far anteriorly as operculum, a tooth just posterior to operculum, sides of orifice convex anteriorly, orifice usually slightly longer than wide; eighth abdominal setae much shorter than, and caudal ones about as long as, width of orifice . . . . *liquidambaris*, n. sp.
   Bottom of vasiform orifice reaching just anterior to posterior margin of operculum, a tongue at end of orifice, sides of orifice nearly vertical anteriorly, orifice practically as wide as long (fig. 8); eighth abdominal setae nearly as long as, and caudal setae much longer than, width of orifice . . *vaccinii*, n. sp.
8. Subdorsal disk pores fairly numerous on abdominal segments 3–5, 3–5 pairs on segment 3, 2–4 pairs on segment 4, and 1–3 pairs on segment 5; vasiform orifice at least its length from body margin; caudal setae nearer together than eighth abdominal ones . . . . *epigaeae*, n. sp.
   Subdorsal disk pores unusually numerous on abdominal segments 3–5, 8–13 pairs on segment 3, 5–9 pairs on segment 4, and 4 or 5 pairs on segment 5; vasiform orifice slightly less than its length from body margin; caudal setae slightly farther apart than eighth abdominal ones . . . . *bignoniae*, n. sp.

Aleuroplatus plumosus (Quaintance)

Aleurodes plumosa Quaintance, U. S. Dept. Agr., Div. Ent., Tech. Ser. **8**: 33–35, illus., in part. 1900.

Tetraleurodes plumosa (Quaintance), Quaintance and Baker, U. S. Dept. Agr., Bur. Ent., Tech. Ser. **27**: 108, in part. 1914.

Aleuroplatus plumosus (Quaintance), Quaintance and Baker, Proc. U. S. Nat. Mus. **51**: 394–395, illus., in part. 1917.

In the original treatment of *A. plumosus* Quaintance stated, "A rather common species in Florida hammocks and higher woodlands; on leaves of various plants, as *Persea carolinensis, Magnolia grandiflora; M. glauca; Ilex opaca; Viburnum nudum* and *Vaccinium* spp." It is uncertain whether specimens from each of these hosts were before Quaintance when he prepared the description of *plumosus*, but at the present time none from *Ilex* or *Viburnum* are in his aleyrodid material in Washington. Quaintance did not designate a holotype of *plumosus*; he included more than one species under the name; and his description applies to one species as well as to another. In 1917 Quaintance and Baker designated a type lot consisting of three mounted specimens, a pupa and one crushed adult of each sex; this pupa should be regarded as the lectotype of the species. These specimens are labeled as having been collected from *Quercus*, a host not specifically listed by Quaintance and not recorded elsewhere in the present paper.

The specimens stated by Quaintance and Baker, in 1917, to be abundant on cranberry in Cranmoor, Wis., apparently should have been recorded from leatherleaf. In unmounted material from this source all specimens of *plumosus* are from leatherleaf, those from cranberry representing the species *epigaeae*. Information associated with this material states that the insects were common on leatherleaf and were found occasionally on cranberry. Quaintance and Baker also assigned some other specimens to *plumosus* which actually belong elsewhere.

Living on the lower surface of leaves.

Perfect specimens with a whitish, waxy exudation extending outward from submargin and upward from dorsum in thin sheets, dorsal tranverse sheets coalesced with longitudinal ones.

Oval, widest across abdominal segments 2 and 3, anterior end almost pointed or narrowly curved, narrower than the broadly curved posterior end; measuring 0.75–1 mm long and 0.50–0.75 wide (males in lower brackets of figures). Black, heavily sclerotized.

Marginal teeth rounded, slightly wider than long, somewhat variable in width, 13–17 in 100μ; 3–5 at each tracheal pore area longer and with incisions between them wider at base than incisions between other teeth. Submarginal teeth equidistant from and about the width of a tooth from marginal teeth, smaller than marginal ones, 3–5 at each tracheal pore area larger than others; their apices heavily and the remainder rather lightly sclerotized. Ridges extending from margin to submarginal disk pores. Submarginal disk pores in a single row, some irregularly spaced and placed, the majority two to three times the width of a marginal tooth from marginal teeth, absent opposite tracheal pore areas, approximately one-third as numerous as teeth.

Transverse molting suture curved posteriorly from its midpoint but recurved cephalad and terminating nearly opposite its center, in outer subdorsum. Cephalothoracic suture weak or absent, pro-mesothoracic suture rather weak, other segmental sutures well defined to inner subdorsum; third through seventh abdominal ones weakly defined to outer subdorsum, their ends curved cephalad. Eye spots transverse, slightly lighter than adjacent derm, inconspicuous. A submedian pair of cephalic, mesothoracic and metathoracic setae, each less than 9μ long; eighth abdominal setae about 60μ, located just laterocephalad of vasiform orifice; caudal setae about 80μ, slightly nearer together than eighth abdominal pair, slightly nearer to orifice than to submarginal teeth, a small, transverse thickening between them. A pair of minute setal bases usually near central subdorsal disk pores on each of abdominal segments 3–6, sometimes a central subdorsal pair on prothorax, posterior to eye spots. Dorsal disk pores somewhat variable in number and position, the subdorsal ones often less numerous in males than in females; abdominal ones usually grouped; pairs arranged approximately as follows: Cephalic segment, 1–3 near median line in center of segment and 1 each side of cephalic setae; prothorax, 1 near median line and 1 (usually central) subdorsal; meso-

thorax, 2 near setae, 2 inner subdorsal (or 1 outer submedian), and 1 central subdorsal; metathorax, 1 or 2 near setae, 2 inner subdorsal (or 1 outer submedian), and 2 or 3 central subdorsal; first abdominal, 2 submedian; second abdominal, 1 submedian; third through sixth, each 2 submedian, 1 inner and 1–3 (usually 2 or 3) central subdorsal; seventh, 1 submedian, 1 inner and 0 or 1 central subdorsal; eighth, 1 inner subdorsal (opposite widest part of orifice). Vasiform orifice less than its length from body margin, longer than wide, measuring about 50–60μ long (from rim at anterior end to edge of rim around posterior end) and 36–46 wide; its rim rather thick and pronounced, and entirely vertical or produced diagonally backward at posterior end; sides of orifice nearly vertical, its bottom extending just anterior to posterior margin of operculum; an apically curved, transverse tongue midway between operculum and end of orifice. Operculum sculptured, broadly curved posteriorly, 24–30μ long and wide.

Minute spines on ventral surface, in a band paralleling body margin.

Lectotype.—U.S.N.M. No. 19195. Florida, from *Quercus.*

Redescribed from a few unmounted specimens and about 55 mounted ones as follows: *Quercus* sp., Florida, A. L. Quaintance, 9-1-98 (lectotype); *Magnolia* sp., Florida, paratypes; *Persea borbonia* (L.) Spreng. (= *P. carolinensis* Nees), Florida, A. L. Quaintance, 5-25-98 (possibly paratype but not so labeled); myrtle bay, Citra, Fla., February 10, 1895; leatherleaf, Cranmoor, Wis., C. W. Hooker, April 25 and August 27, 1910; leatherleaf, April 17, and blueberry, July 18, 1914, Pemberton, N. J., H. B. Scammell; inkberry, Whitesbog, N. J., H. B. Scammell, February 17, 1915, and March 13, 1916; *Myrica* sp., Lake Weir, Fla., H. W. Fogg, October 1923; laurel, Washington, D. C., W. B. Wood, July 26, 1927; *Kalmia* sp., Silver Spring, Md., Louise M. Russell, October 11, 1942; *Vaccinium corymbosum* L., Pemberton, N. J., C. S. Beckwith, September 27, 1943.

Aleuroplatus semiplumosus, n. sp.

Differing from *A. plumosus* as follows: Body widest across abdominal segments 1 and 2, posterior end nearly as narrow as anterior end. No thickening between caudal setae. Two central subdorsal pairs of minute setal bases on prothorax, abdominal ones usually near inner subdorsal disk pores except on segment 3. Submedian and inner subdorsal disk pores on abdominal segments 3–5 somewhat equally spaced rather than grouped; 2 or 3 submedian and inner subdorsal, and 3 or 4 central subdorsal (a total of 7 or 8) pairs on segment 3; 1–3 inner and central subdorsal pairs on segments 4, 5, and sometimes on 6, but central subdorsal sometimes absent from segments 5 and 6, and usually absent from segment 7. Vasiform orifice 56–64μ long and 36–44 wide; lower part of sides opposite operculum forming a somewhat thickened and heavily sclerotized vertical wall close to the operculum and following its curve, the wall interrupted abruptly at its posterior end and a somewhat spatulate tongue in interval between its ends; membrane sloping outward and upward from wall to rim of orifice.

Type.—U.S.N.M. No. 56951. Norfolk, Va., from *Persea.*

Described from many unmounted specimens and 91 mounted ones as follows: *Ilex opaca* Ait., Vienna, Va., A. C. Baker, March 2, 1912; holly, Urbana, Ill., C. O. Woodworth, December 23, 1915; Lauraceae, Bamboo Garden near Savannah, Ga., H. L. Sanford, February 28, 1922; American holly, Silver Spring, Md., Carlo Zeimet, April 2, 1922; laurel, Bethesda, Md., R. D. Kennedy, April 26, 1922; *Sassafras albidum* (Nutt.) Nees, Rock Creek Park, Washington, D. C., J. E. Walter, August 6, 1922; laurel, Cass, W. Va., F. W. Gray, August 1922; *Nyssa sylvatica* Marsh.? and laurel, Black Mountain, N. C., Carlo Zeimet, September 7, 1922; holly, Holly Springs, Miss., T. F. McGehee (from R. W. Harned), 1922; *Persea* sp., New Orleans, La., H. L. Dozier, January 20, 1923; *Ilex* sp., Glendale, Md., R. G. Cogswell, September 27, 1923; *Rhododendron* sp., Baltimore, Md., C. E. Prince, May 9, 1924; *Kalmia latifolia* L., Fort Myer, Va., H. L. Sanford, May 27, 1924; *Rhododendron* sp., Kennett Square, Pa., W. B. Wood, August 10, 1932, and W. W. Chapman and W. J. Ehinger, June 25, 1935; *Kalmia latifolia* L., near Sperryville, Va., H. H. Keifer, June 4, 1940; *Kalmia* sp. and *Ilex* sp., Silver Spring, Md., Louise M. Russell, April 29, 1943; *Persea borbonia* (L.) Spreng., Norfolk, Va., L. D. Anderson, August 10 and 30 (including holotype), 1943; *Persea pubescens* (Pursh)

Sarg., Richmond Hill, Ga., L. A. Mayer, December 2, and Max Kisliuk, December 13, 1943.

The only available third-stage specimen of this species has submedian mesothoracic and metathoracic setae, and a vasiform orifice similar to that of the pupae.

Aleuroplatus myricae Quaintance and Baker

Aleuroplatus myricae Quaintance and Baker, Proc. U. S. Nat. Mus. **51**: 389–390, illus. 1917.
Aleuroplatus plumosus (Quaintance), Quaintance and Baker, Proc. U. S. Nat. Mus. **51**: 395, in part. 1917.

A specimen from cranberry, New Egypt, N. J., assigned to *plumosus* by Quaintance and Baker, belongs to *myricae*.

Differing from *A. plumosus* as follows: Widest across abdominal segments 1 and 2, posterior end of body nearly as narrow as anterior end. Caudal setae nearer to submarginal teeth than to vasiform orifice. Abdominal minute setal bases usually near inner subdorsal disk pores except on segment 3, sometimes absent from any one of segments 4–6. Dorsal disk pores less numerous, usually 1 submedian and 2 subdorsal pairs on meso- and metathorax, frequently only 1 submedian pair on one or another of abdominal segments 1 and 4–6, abdominal central subdorsal ones usually present only on segment 3. Vasiform orifice around 45μ long and 40 wide, approximately its length from body margin; tongue at end of orifice.

Lectotype.—U.S.N.M. No. 19198. Griffin, Ga., from *Myrica*.

Redescribed from a few unmounted specimens and 30 mounted ones as follows: *Myrica pensylvanica* Loisel. (identified by botanists of U. S. Dept. Agr.), Griffin, Ga., A. L. Quaintance, April 25, 1899 (including lectotype, hereby designated); cranberry, New Egypt, May 21, 1914, and New Lisbon, April 26, 1915, and sheep laurel, Pemberton, N. J., February 23, 1915, H. B. Scammell; *Kalmia* sp. and *Rhododendron nudiflorum* (L.) Torr., Sligo Park, Silver Spring, Md., Louise M. Russell, November 6, 1943.

The only available third-stage specimen of *myricae* has submedian meso- and metathoracic setae, and a vasiform orifice similar to that of the pupae.

Aleuroplatus magnoliae, n. sp.

Aleurodes plumosa Quaintance, U. S. Dept. Agr., Div. Ent., Tech. Ser. **8**: 33–35, in part. 1900.
Tetraleurodes plumosa (Quaintance), Quaintance and Baker, U. S. Dept. Agr., Bur. Ent., Tech. Ser. **27**: 108, in part. 1914.
Aleuroplatus plumosus (Quaintance), Quaintance and Baker, Proc. U. S. Nat. Mus. **51**: 394–395, in part. 1917.

The specimens treated here doubtless are the ones from *Magnolia glauca* included under *plumosus* by Quaintance; some are labeled *plumosus* but are not marked cotype.

Differing from *A. plumosus* as follows: Slightly constricted at posterior third. Submarginal disk pores approximately one-half as numerous as teeth, usually forming a double row in spots; porettes of these and dorsal disk pores relatively conspicuous. Eye spots conspicuous, much lighter than adjacent derm, slightly elevated, irregularly elliptical. No thickening between caudal setae. Two central subdorsal pairs of minute setal bases on prothorax, abdominal ones usually inner subdorsal except on segment 3. Three submedian pairs of disk pores on first, and 2 on second abdominal segment; each of abdominal segments 3–6 with a row of pores ending slightly mesad of central subdorsal area, those at ends of row grouped on segments 3 and 4; usually 3 submedian pairs on each of segments 3–6; 6 subdorsal pairs on segment 3, 4 or 5 on segment 4, 3 or 4 on segment 5, 2 or 3 on segment 6; 2 submedian and 1 subdorsal pair on segment 7. Sides of vasiform orifice slightly convex laterally and strongly so posteriorly, at posterior end the upper portion of convex area rimlike and nearly as high as operculum, membrane sloping from this rim to outer edge of true rim of orifice which projects backward; orifice measuring 56–60μ long and 40–44 wide; without a tongue.

Type.—U.S.N.M. No. 56952. Lake City, Fla., from *Magnolia*.

Described from 17 mounted specimens from *Magnolia virginiana* L. (=*M. glauca* L.), Lake City, Fla., A. L. Quaintance.

Aleuroplatus ilicis, n. sp.

No conspicuous waxy exudation observed, body covered by a thin coating of transparent glassy wax.

Differing from *A. plumosus* as follows: Body constricted at posterior third, bulging anterior to this point. Eye spots conspicuous, much lighter than adjacent derm, slightly elevated, subcircular to roughly elliptical. Eighth abdominal setae around 12μ long; caudal setae usually around 40μ, no thickening between them. Usually 2 pairs of central subdorsal minute setal bases on prothorax and 0 on abdomen. Dorsal disk pores less numerous, usually 1 pair near cephalic and mesothoracic, and 0 near metathoracic setae; 1 inner and 1 central subdorsal pair on each thoracic segment; 1 submedian pair on each of abdominal segments 1–7, 1 inner subdorsal pair on each abdominal segment, and 1 central subdorsal pair on segment 3 and occasionally on segment 4 or 5. Vasiform orifice approximately its length from body margin, usually slightly longer than wide but sometimes as wide as long, measuring 44–56μ long and 40–48 wide; sides of orifice thickened, strongly sclerotized, and strongly convex opposite operculum, thinner and nearly vertical at posterior end; bottom of orifice extending cephalad nearly as far as operculum; a flat or peglike tooth arising from bottom of orifice at end of operculum.

Type.—U.S.N.M. No. 56953. Silver Spring, Md., from *Ilex.*

Described from many unmounted specimens and 66 mounted ones as follows: Holly, Urbana, Ill., C. O. Woodworth, December 23, 1915; *Kalmia* sp., Lea Springs, Tenn., October 4, 1909; *Ilex* sp., near Brooksville, Fla., H. L. Sanford, February 14, 1922; laurel, Cass, W. Va., F. W. Gray, August 1922; laurel, Black Mountain, N. C., Carlo Zeimet, September 7, 1922; holly, Holly Springs, Miss., T. F. McGehee (from R. W. Harned), 1922; holly, Richmond, Va., F. R. Freund, May 4, 1939; *Ilex opaca* Ait., Silver Spring, Md., Louise M. Russell, May 10 (including holotype) and June 7, 1942; holly, Gordo, Ala., collected in Calif. by D. D. Sharp (from H. L. McKenzie), December 22, 1942; common and dahoon holly, Chapel Hill, N. C., F. J. LeClair (from C. S. Brimley), May 4, 1943; *Ilex* sp., Richmond Hill, Ga., Max Kisliuk, December 6, 1943.

Mesothoracic and metathoracic setae are present in the only third-stage specimen available. In this insect the bottom of the vasiform orifice is relatively much shorter than in the pupa and there is a suggestion of a spatulate tongue at the end of the orifice. In three first-stage specimens at hand the submedian meso- and metathoracic setae are present and are practically the same size as the cephalic ones.

This species is sometimes abundant, literally covering the lower surface of the leaves. It is very difficult to mount satisfactorily.

Aleuroplatus liquidambaris, n. sp.

Aleurodes plumosa Quaintance, U. S. Dept. Agr., Div. Ent., Tech. Ser. **8**: 33–35, in part. 1900.
Tetraleurodes plumosa (Quaintance), Quaintance and Baker, U. S. Dept. Agr., Bur. Ent., Tech. Ser. **27**: 108, in part. 1914.
Aleuroplatus plumosus (Quaintance), Quaintance and Baker, Proc. U. S. Nat. Mus. **51**: 394–395, in part. 1917.

Some specimens originally assigned to *plumosus* by Quaintance, and apparently later considered as belonging to that species by Quaintance and Baker, must be transferred to *liquidambaris.*

Differing from *A. ilicis* in lacking submedian meso- and metathoracic setae, in sometimes having a metathoracic submedian pair of disk pores, and in usually having at least 1 pair of abdominal minute setal bases.

Type.—U.S.N.M. No. 56954. New Orleans, La., from *Liquidambar.*

Described from a few unmounted specimens and 40 mounted ones as follows: *Vaccinium* sp., Florida, A. L. Quaintance (labeled cotype of *plumosus*); *Magnolia* sp. (presumably *grandiflora* L., judged from Quaintance collection notes and data published with *plumosus*), Florida, A. L. Quaintance (labeled cotype of *plumosus*); *Asimina* sp., Lake City, Florida, A. L. Quaintance, August 24, 1897; *Liquidambar styraciflua* L., A. L. Quaintance; *L. styraciflua* L., New Orleans, La., H. K. Plank, September 17, 1924 (including holotype); *L. styraciflua* L., St. Leonard, Md., October 6, 1940, and *Pyracantha coccinea* Roem., Silver Spring, Md., October 7, 1941, Louise M. Russell.

Specimens from *Magnolia* and *Vaccinium* differ from the others included here in that most of them have a metathoracic pair of submedian disk pores and at least one pair of abdominal minute setal bases. It is believed, however, that they are conspecific.

This species is very similar to *A. ilicis*, the only seemingly important difference observed

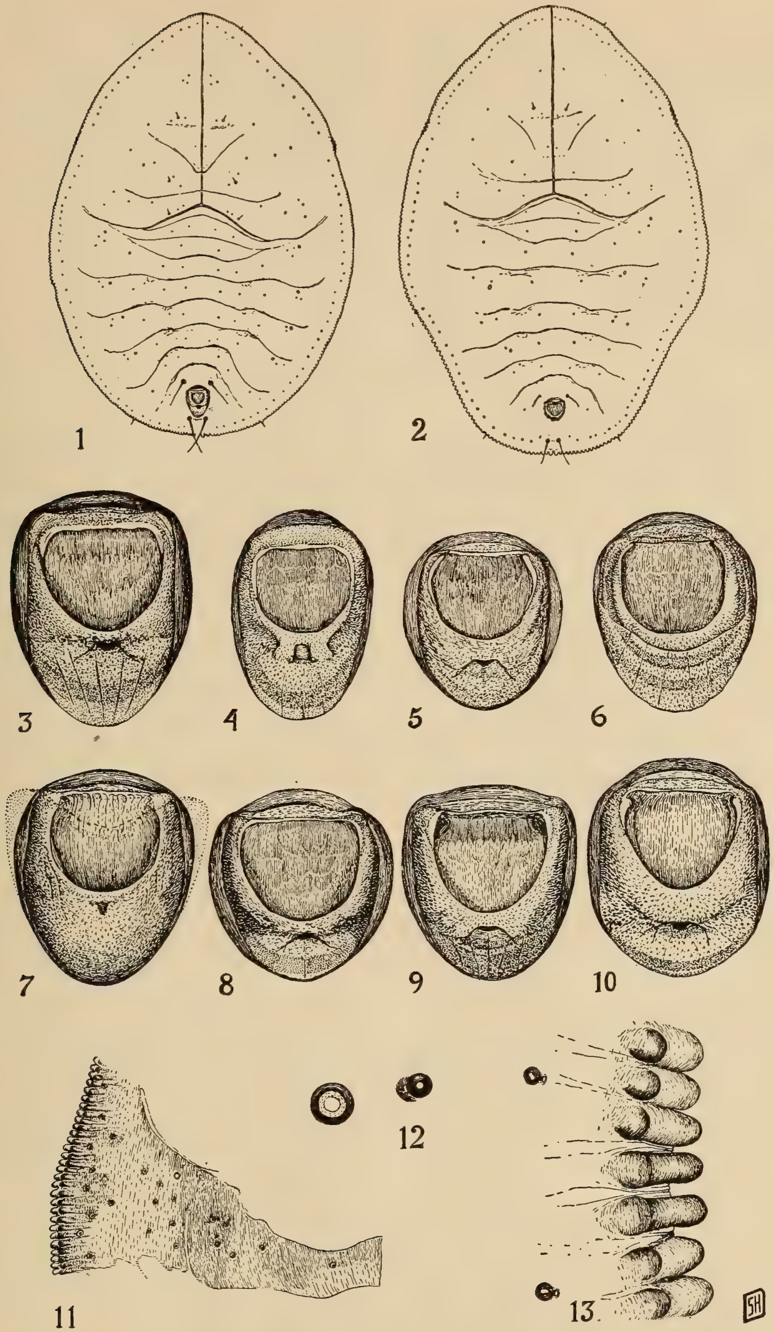

Fig. 1.—*Aleuroplatus plumosus*, dorsum, ×50. Fig. 2.—*A. vaccinii*, dorsum, ×50. Fig. 3.—*A. plumosus*, vasiform orifice, ×460. Fig. 4.—*A. semiplumosus*, vasiform orifice, ×460. Fig. 5.—*A. myricae*, vasiform orifice, ×460. Fig. 6.—*A. magnoliae*, vasiform orifice, ×460. Fig. 7.—*A. ilicis*, vasiform orifice, ×460. Fig. 8.—*A. vaccinii*, vasiform orifice, ×460. Fig. 9.—*A. epigaeae*, vasiform orifice, ×460. Fig. 10.—*A. bignoniae*, vasiform orifice, ×460. Fig. 11.—*A. bignoniae*, half of third abdominal segment, ×165. Fig. 12.—*A. semiplumosus*, minute setal base, disk pore and porette, ×1,500. Fig. 13.—*A. vaccinii*, margin and submargin around thoracic tracheal pore area, ×650. (Drawings by Sara Hoke DeBord.)

being the absence of submedian meso- and metathoracic setae. This difference is thought to be important, however, because there is very little variation in this character in the pupae of the species discussed in this paper. Also, in the few third-stage specimens examined, the meso- and metathoracic setae are present or absent just as in the pupae of the same species. They are absent in the third-stage specimen of *liquidambaris.* There is a distinct spatulate tongue in the vasiform orifice of this specimen, and the bottom of the orifice is relatively shorter than in the pupae.

Aleuroplatus vaccinii, n. sp.

Aleuroplatus plumosus (Quaintance), Quaintance and Baker, Proc. U. S. Nat. Mus. **51**: 395, in part. 1917.

Certain specimens from cranberry, New Egypt, N. J., assigned to *plumosus* by Quaintance and Baker belong to this new species.

Differing from *A. ilicis* as follows: Eye spots moderately conspicuous, not elevated. Eighth abdominal setae 35μ long; caudal setae about 60μ, nearer to submarginal teeth than to vasiform orifice, a faint thickening between them. Usually 0 or 1 pair of central subdorsal minute setal bases on prothorax, 1 central subdorsal pair on abdominal segment 3, and usually 1 inner subdorsal pair on segments 4, 5, and sometimes 6. A submedian pair of disk pores on metathorax, and 1 or 2 central subdorsal pairs on each segment of thorax and on abdominal segments 3 and 4. Vasiform orifice about one and one-half times its length from body margin, 40–44μ long and 38–44 wide, its sides nearly vertical, its bottom extending just anterior to posterior margin of operculum; a curved tongue at end of orifice.

Type.—U.S.N.M. No. 56955. Pemberton, N. J., from *Vaccinium.*

Described from many unmounted specimens and 97 mounted ones as follows: Pipsissewa, Orono, Maine, May 6, 1899; cranberry, New Egypt, May 21, 1914, wintergreen, Pemberton, February 23, 1915, and inkberry, Whitesbog, N. J., March 13, 1916, H. B. Scammell; *Chimaphila umbellata* (L.) Barton, Southold, N. Y., from E. P. Felt, October 1919; *Gaylussacia frondosa* (Wang) Torr. & Gray, Takoma Park, Md., Carlo Zeimet, August 6, 1922; *Gelsemium sempervirens* (L.) Ait. f., Savannah, Ga., collected at Washington, D. C., W. T. Owrey, August 11, 1922; *Gaylussacia baccata* Wang and *Nyssa sylvatica* Marsh.?, 1922, Black Mountain, N. C., Carlo Zeimet, September 7, 1922; *Ilex* sp., Glendale, Md., R. G. Cogswell, December 1923; undetermined host, Washington, D. C., W. B. Wood, July 26, 1927; *Kalmia latifolia* L., Washington, D. C., R. G. Cogswell, May 24, 1928; laurel, Washington, D. C., W. B. Wood, June 8, 1931; *Chimaphila umbellata* (L.) Barton, Greensboro, Ind., W. B. Wood, April 27, 1937; *Pyrola* sp., Canada, intercepted at Boston, Mass., J. T. Beauchamp, May 16, 1940; *Vaccinium corymbosum* L., Pemberton, N. J., C. S. Beckwith, August 30 and September 27 (including holotype), 1943; *Chimaphila umbellata* (L.) Barton, and *Vaccinium vacillans* Torr., Sligo Park, Silver Spring, Md., Louise M. Russell, November 6, 1943.

The two available third-stage specimens lack submedian mesothoracic and metathoracic setae and have the vasiform orifice as in the pupae.

This species is suspected of being a vector of the blueberry stunt virus disease.

Aleuroplatus epigaeae, n. sp.

Differing from *A. plumosus* as follows: Submedian meso- and metathoracic setae absent. Caudal setae as near to submarginal teeth as to vasiform orifice. Abdominal minute setal bases inner subdorsal except on segment 3, often absent from segments 5 and 6. Usually 1 pair of central subdorsal disk pores on metathorax; abdominal segments 6, 7, and sometimes 5 without central subdorsal pores, 1 or 2 inner subdorsal pairs on each of segments 3–5, often only 1 submedian pair on segment 6; outer submedian pair on any segment usually as near to inner subdorsal as to inner submedian pair. Vasiform orifice slightly more than its length from body margin, measuring 44–52μ long and 44–48 wide; tongue at end of orifice.

Type.—U.S.N.M. No. 56956. Silver Spring, Md., from *Epigaea.*

Described from many unmounted specimens and 107 mounted ones as follows: Cranberry, Cranmoor, Wis., C. W. Hooker, October 7, 1910 (see discussion under *plumosus*); *Epigaea repens* L., Reading, Pa., J. G. Sanders, May 17, 1917; blueberry (in greenhouse), Washington,

D. C., H. L. Sanford, August 23, 1919; *E. repens* L., Mattituck, N. Y., Roy Latham, July 18, 1920; wintergreen, Albany, N. Y., E. P. Felt, May 16, 1922; laurel, Washington, D. C., W. B. Wood, July 26, 1927, and R. G. Cogswell, May 24, 1928; blueberry (in greenhouse), Washington, D. C., September 2, 1932; *E. repens* L., Prince Edward Island, New Brunswick, and Nova Scotia, Canada, intercepted at Boston, Mass., by J. T. Beauchamp, W. J. Ehinger, and E. Hodson, May 23, 1939, to May 4, 1943; *E. repens* L., Sligo Park, Silver Spring, Md., Louise M. Russell, November 6, 1943 (including holotype).

In the lot containing the holotype, 2 third-stage specimens lack submedian mesothoracic and metathoracic setae; 2 apparently second-stage insects lack mesothoracic setae, but a metathoracic one is suggested on one half of one specimen and on each half of the other; in 10 first-stage insects, mesothoracic and metathoracic setae are present but are much smaller than the cephalic ones. The vasiform orifice of the third-stage specimens is similar to that of the pupae.

This species was abundant on some samples of *Epigaea* examined by the writer. It is rather similar to *A. myricae.*

Aleuroplatus bignoniae, n. sp.

Differing from *A. plumosus* as follows: Submedian mesothoracic and metathoracic setae absent; caudal setae slightly farther apart than eighth abdominal ones and nearer to submarginal teeth than to orifice. Two pairs of central subdorsal minute setal bases on prothorax, abdominal ones usually nearer to inner than to central subdorsal disk pores except on segment 3. One distinctly submedian pair of dorsal disk pores on each of abdominal segments 1–7; subdorsal abdominal ones unusually numerous, more or less grouped in inner, central, and outer subdorsum, the outer ones sometimes nearly indistinguishable from submarginal ones; abdominal segment 3 with 8–13 pairs, segment 4 with 5–9 pairs, segment 5 with 4 or 5 pairs, segment 6 with 2–4 pairs, segment 7 with 1 pair. Vasiform orifice around 56μ long and 48 wide; tongue located at end of orifice.

Type.—U.S.N.M. No. 56957. Brooksville, Fla., from *Bignonia.*

Described from several unmounted specimens and six mounted ones from *Bignonia* sp., Brooksville, Fla., H. L. Sanford, Feb. 11, 1922.

The one available third-stage specimen lacks meso- and metathoracic setae, and has the vasiform orifice similar to that of the pupae.

ZOOLOGY.—*Tests indicating absence of progesterone in certain avian ovaries.*[1]

Oscar Riddle and James Plummer Schooley,[2] Carnegie Institution of Washington, Cold Spring Harbor, N. Y.

Histological evidence of the presence of luteal tissue in the ovary of fowl, and of some other birds, has been frequently asserted and perhaps still more frequently denied. This subject was treated extensively by Fell (1925). In reptiles, however, histological studies seem to have demonstrated the presence of a typical corpus luteum in some species and its absence in others. In certain viviparous lizards both macroscopic and microscopic evidence of corpora lutea was noted by Hett (1924), Weekes (1934), and Cunningham and Smart (1934). The last-named authors also noted the absence of corpora in oviparous lizards. Clausen (1935) briefly reported important observations on the presence, and on effects of removal (total ovariectomy), of "luteal" bodies in viviparous snakes. Fraenkel and Martins (1938) noted the presence, in pregnant viviparous snakes, of bodies indistinguishable from the corpora lutea of mammals and further showed that these corresponded in number to the ova or embryos present in the oviducts. At this stage in the development of the subject a short abstract of results of the present study was published. (Riddle and Schooley, 1938a).

Further morphological studies on the corpora of viviparous snakes have been made by Rahn (1938; 1939) and Fraenkel and Martins (1939; 1940). Porto (1941) made crude ethanol extracts of such corpora

[1] Received June 24, 1944.
[2] Now director of Endocrine Laboratories, Difco Laboratories, Inc., Detroit, Mich.

and showed that they contained progesterone. It should be noted that Porto's tests were made by *subcutaneous* injection into immature rabbits to which 10 I.U. of estradiol benzoate had been administered daily for eight days. Though relatively large amounts of progesterone are required for detection following subcutaneous injection, an extract from only 2.9 gm of corpora from pregnant snakes was shown to contain progesterone. Slightly preceding this group of studies, McGinty, Anderson, and McCullogh (1938; 1939) developed a highly sensitive method by which as little as 0.25 to 1 μg of crystalline progesterone may be detected. That method made it practicable to carry out the present study, since fowl and pigeon ovaries could be expected to contain only minute amounts of progesterone. In Corner's laboratory Haskins (1939) observed that as little as 0.25 gamma of progesterone, also the amount present in 0.2 cc serum from a pregnant guinea-pig, may be detected by the McGinty test. Later, Haskins (1940) reported important studies in which mitotic counts in the uterine epithelium were utilized to increase the sensitivity of the test, and also to make it usable for the quantitative assay of progesterone.

Besides contributing to our growing knowledge of progesterone production in oviparous and viviparous vertebrates, it was hoped that the results of the present study might incidentally provide information bearing on the role of progesterone in the induction of broodiness in lower vertebrates. Noble, Kumpf, and Billings (1938) noted that progesterone, like prolactin, has the ability to induce broody behavior in normal and castrate jewelfish; and Riddle and Schooley (1938b) observed that some male and female ring doves could be made completely broody within 2 to 5 days by temporary implantation of pellets of progesterone. If bird ovaries were found to contain much progesterone this would provide at least a possibility that this hormone may participate in the onset or regulation of broodiness; if bird ovaries were shown to contain no progesterone any physiologically significant role of this hormone in broodiness would be rendered doubtful or excluded. This question has not been definitely answered, however, by the present study. It has been shown that properly conducted tests on three samples of bird ovaries, all of which were suitable for test (since they contained ovulated follicles in various early stages of regression and a few growing follicles), failed to show the minute amount of progesterone that is detectable by the McGinty test.

MATERIAL

Tests were made on a sample of rat ovaries, a sample of pigeon ovaries, and on two samples of fowl ovaries. Each of the two samples of fowl ovaries, prepared for study of their progesterone content, was derived from three hens belonging to three different breeds (Rhode Island Red, Plymouth Rock, White Rock); in all these breeds the hens are usually capable of becoming broody. These six laying hens, whose egg-laying records were accurately known for the previous five days, were removed from fenced-in "runs" on an adjacent farm to similar "runs" at the laboratory three days before their ovaries were removed; trap-nest records were continued to the time of killing for samples. During this 3-day interval one group of three hens received no treatment except such as was incidentally connected with their change of habitat and food; though these changes usually diminish egg production, laying was not immediately suppressed in either of these three birds and both unovulated follicles and ovulated follicles in various stages of regression were found in each of the three ovaries. Extract *A* was prepared from the ovaries of this group. Two of the three hens of the other group laid irregularly during the total of eight days for which trap-nest records were kept; each of these hens received 1,000 units (3.33 mg) of luteinizing hormone from pregnancy urine daily during the last three days, and although only one of them was definitely known to lay during this period (two eggs were laid outside the trap-nest) rather recently emptied follicles were found at autopsy in all cases. Extract *B* was prepared from the ovaries of this

group. In all cases the walls of all ova (follicles) more than 2 mm diameter were slit open and the yolk contents eliminated from the sample. Thus 16.8 gm of ovarian tissue, including the thick walls of unovulated and of recently ovulated follicles, was the starting point for extract *A*, and 12.1 gm the source of extract *B*. These two samples of ovarian tissue were then subjected to Allen's (1932) method for the preparation and purification of progesterone. Each extract was injected into two rabbits, one of which (lower ones on table 1), however, received more than two-thirds of the preparation. The McGinty method was followed closely with the exception that any progesterone contained in our extracts was not in solution in peanut oil but in unseparated fatty material (soluble in methyl alcohol) from the bird's own ovary. These tests were made during May-June.

The pigeon ovaries selected for extraction and study were obtained within 20 hours after the ovulation of the second ovum of the clutch. This period is practically coincident with the onset of broodiness in pigeons, and the two ovulated follicles had, respectively, undergone 64 and 20 hours of regression.

Most of the rabbits used were of a large breed, New Zealand White. All were less than 2.0 months old when priming with estrone was started.

RESULTS

Table 1 gives details of the dosages used and the results of treatments. The data indicate that the simultaneous presence of some lipoid material other than progesterone—such as is contained in a crude methyl alcohol extract of brain tissue—did not measurably affect the sensitivity of the McGinty test for progesterone. Though the rabbits used gave positive tests with 1 μg progesterone, with or without admixture of the brain extract, two rabbits were wholly negative to extracts (*A* and *B*) from approximately 10 gm of prepared fowl ovary; two other rabbits were wholly negative to slightly less than one-half that quantity of the extracts. A crude extract from only 120 mg of luteinized rat ovary gave a reaction equal to that obtained with 1 or 2 μg of progesterone. The "plus" signs (+ to +++) of the table are not necessarily the same as those of previous workers; they represent degrees of stimulation observed in our tests.

Table 1.—Data Relating to Tests for Progesterone in Extracts of Ovaries of Fowl, Pigeons, and Rats by Injection into Uteri of Immature Rabbits

Rabbit weight	Material and quantity in cc injected into—				Progestational proliferation	
	Right horn		Left horn		Right	Left
		cc		cc		
963	4 μg progesterone..........	0.2	Sesame oil...........	0.2	+++	−
900	Extr. pigeon ovary[1]........	0.2	Crude extr. brain[2]....	0.2	−	−
1775	Part extract *A*[3]............	0.25	2 μg progesterone.....	0.1	−	++
1695	Part extract *B*[4]............	0.2	1 μg progesterone.....	0.05	−	+
1075	Remainder extract *A*[3]......	0.6	None...............		−[5]	−
1090	Remainder extract *B*[4]......	0.5	None...............		−[5]	−
1185	1 μg prog. +brain extr......	0.2	1 μg progesterone.....	0.1	++	+
1760	4 μg. prog.[6] +brain extr.....	0.2	4 μg progesterone	0.2	+	+++
1250	1 μg progesterone..........	0.1	Extr. rat ovary[7]......	0.2	++	++

[1] Crude methyl alcohol extract (73 mg) of two pigeon ovaries (1.0 gm).

[2] Similar crude methyl alcohol extract (50 mg) of brain of pigeons.

[3] The smaller dose (0.25 cc) represented 30 percent, and the larger dose (0.6 cc) 70 percent, of the total "progesterone fraction" obtained from 16.8 gm of fowl ovaries.

[4] The smaller dose (0.2 cc) represented 29 percent, and the larger dose (0.5 cc) 71 percent, of the total "progesterone fraction" obtained from 12.1 gm of ovaries from treated fowl.

[5] The isolated loop of the uterus was distended with purulent fluid.

[6] A considerable fraction of this material was lost at injection.

[7] The injected material (not weighed) was a crude, methyl alcohol extract of 120 mg of rat ovary heavily luteinized with a preparation from pregnancy urine.

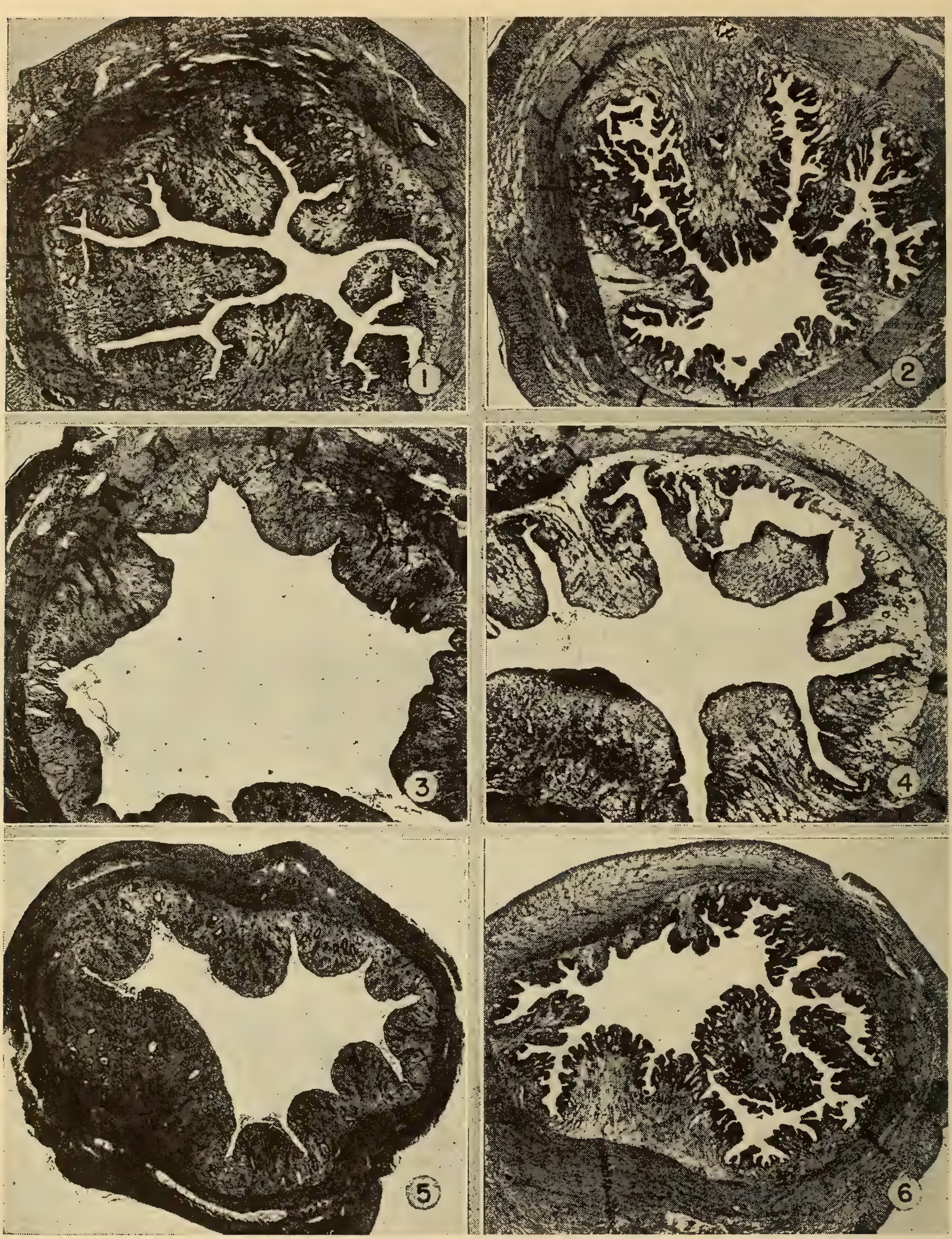

Fig. 1.—Left horn of rabbit uterus (control) injected with 0.2 cc sesame oil. No progestational proliferation. Fig. 2.—Right horn of rabbit uterus injected with 1μg progesterone + brain extract (0.2 cc). Well-marked progestational proliferation. Fig. 3.—Right horn of rabbit uterus injected with extract *A* (0.6 cc) from 11.7 gm fowl ovaries. Distention but no progestational proliferation. Fig. 4.—Right horn of rabbit uterus injected with extract *B* (0.5 cc) from 8.6 gm of ovaries from fowl treated for three days with human pregnancy urine. Distention but no progestational proliferation. Fig. 5.—Right horn of rabbit uterus injected with extract *B* (0.2 cc) from 3.5 gm of ovaries from fowl treated for three days with human pregnancy urine. No progestational proliferation. Fig. 6.—Left horn of rabbit uterus injected with crude extract of 120 mg rat ovary luteinized with human pregnancy urine. Well-marked progestational proliferation.

The condition of several uteri following treatment with extracts of various types of ovaries is shown in Figs. 2–6. A control uterus, injected with sesame oil only (Fig. 1) and three of the uteri treated with extracts *A* and *B* (Figs. 3–5) show no progestational proliferation. A uterus treated with 1 μg progesterone+brain extract (Fig. 2), and another treated with extract of rat ovary (Fig. 6), show such proliferation clearly.

DISCUSSION

The studies of Fraenkel and Martins, and of Porto, seem to have demonstrated that corpora lutea and progesterone (i.e., a substance able to induce progestational proliferation) are produced in some viviparous reptiles. It was thus made evident that vertebrates both lower and higher than birds are capable of producing luteal cells and progesterone. The fact that some *families* of lizards and snakes contain both oviparous and viviparous species—and that the viviparous forms are presumably derived from oviparous ancestors—suggests that a *latent* capacity to produce this hormone may be widespread among exclusively oviparous forms, such as birds. Indeed, it may now be regarded as probable that a wide distribution of that latent capacity was a prerequisite for the origin and success of intrauterine embryonic development in several unrelated genera of reptiles and in (early) mammals. Perhaps only special endocrine and oviducal states or conditions can convert this latent capacity into the actual formation of luteal cells (and of progesterone production in detectable amounts) in oviparous birds, and certainly not all these states or conditions were subjected to test in this investigation. The present study is a contribution to this problem since, for the first time, the ovaries of two oviparous species have been tested for the presence or absence of progesterone. Tests on other species and reproductive states will require several additional investigations. All that is claimed for the present study is that the ovaries utilized by us were shown to contain either no progesterone or an amount which is relatively insignificant in comparison with that found in ovaries of mammals.

The apparent ability of progesterone to induce broodiness in some fishes (Noble, Kumpf, and Billings, 1938) and birds (Riddle and Schooley, 1938b; Riddle and Lahr, 1944), and its similar ability to initiate maternal behavior in rats (Riddle, Lahr, and Bates, 1942), provided a special reason for interest in the outcome of our search for progesterone in the ovaries of fowl and pigeons. If progesterone is a substance directly concerned in the release of broodiness, and not merely one of a variety of substances having ability to cause the pituitary to release the directly effective hormone (Riddle, Lahr, and Bates, 1942), it should be possible to obtain detectable amounts of progesterone from the bird ovary. The absence of such amounts of that hormone in the present tests provides an item of evidence, inconclusive though it is, that progesterone is not directly involved in the initiation of broody behavior.

SUMMARY

The sensitive McGinty test showed that a crude extract of 120 mg of luteinized rat ovary contained more than sufficient progesterone to produce definite progestational proliferation in the uterus of an immature rabbit.

Partly purified extracts from 11.7 gm (also from 5.1 gm) of ovarian tissue from three laying hens, and similar extracts from 8.6 gm (also from 3.5 gm) of ovaries of three such hens treated over three days with 3,000 units of luteinizing hormone from pregnancy urine, did not contain an amount of progesterone detectable by theMcGinty test. A test made with a crude extract from two pigeon ovaries (1.0 gm) taken at 20 hours after ovulation of the second egg of the clutch was likewise negative.

Since 0.25 to 1.0 μg of crystalline progesterone, and also the amount of progesterone present in 0.2 cc of serum from a pregnant guinea-pig, are detectable by this method, it is concluded that fowl and pigeon ovaries in the reproductive phases tested by us contain either no progesterone or a relatively insignificant amount in comparison with that found in ovaries of mammals and some viviparous snakes.

It is noted that these results have bearing upon questions involved in the numerous independent origins of viviparity in families of higher vertebrates, and also upon the possibility that progesterone participates in the normal induction of broodiness in birds.

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PROCEEDINGS OF THE ACADEMY AND AFFILIATED SOCIETIES

CHEMICAL SOCIETY

559th Meeting

The 559th meeting was held in the Auditorium of the Cosmos Club at 8:15 p.m. on Thursday, January 13, 1944. The retiring President, Sterling B. Hendricks, Bureau of Plant Industry, Soils, and Agricultural Engineering, U. S. Department of Agriculture, spoke on *Polymer chemistry of silicates, borates, and phosphates.* This address was published in this Journal **34**(8): 241-251. 1944.

560th Meeting

The 560th meeting was held in the Auditorium of the Cosmos Club at 8:15 p.m. on Thursday, February 10, 1944. Donald B. Keyes, professor of chemical engineering, University of Illinois, and chief of the Chemical Industries Branch of the Office of Production Research and Development, War Production Board, spoke on *The chemical side of the Davis-Keyes mission to London.*

561st Meeting

The 561st meeting was held in the Statler Hotel on Thursday, March 9, 1944, at 7:30 p.m. This was the annual dinner meeting of the Society. The Hillebrand Prize for 1943 was awarded to B. H. Nicolet, Bureau of Dairy

Industry, U. S. Department of Agriculture, in recognition of his work on cysteine, threonine, and serine. The speaker of the evening was Milton Harris, of the Textile Foundation. His subject was *Polymer chemistry of wool.*

562d Meeting

The 562d meeting was held in the Auditorium of the Cosmos Club at 8:15 p.m. on Thursday, April 13, 1944. Henry Eyring, professor of chemistry, Princeton University, spoke on *The effects of pressure, temperature, and certain narcotics on bioluminescence.*

563d Meeting

The 563d meeting was held in the Arts and Science Building of the University of Maryland, College Park, Md., on Thursday, May 11, 1944, at 8:15 p.m. Following a brief, general meeting, divisional programs were presented as follows:

Biochemistry, Dean Burk, *presiding*

A chemical and physiological study of mimosine, a new alpha-amino acid in Leucaena glauca. Ruth K. Yoshida (Bureau of Plant Industry, Soils, and Agricultural Engineering).

The determination of estrone in blood. F. P. Veitch, Jr., and H. S. Malone (Georgetown University).

On the mode of action of lipooxidase. Marian W. Kies (Department of Biochemistry, George Washington University).

Inorganic and analytical chemistry, Charles E. White, *presiding*

Low-fluorine calcium phosphates for agricultural uses. W. L. Hill, E. J. Fox, and D. S. Reynolds (Bureau of Plant Industry, Soils, and Agricultural Engineering.

The determination of the optical constants of single microscopical crystals. Charles P. Saylor (National Bureau of Standards).

Visual qualitative analysis with the electric arc. M. J. Peterson, J. D. Richards, and M. F. Sheftel (Bureau of Mines).

Organic chemistry, H. S. Isbell, *presiding*

The development of indicators for acidity and basicity in hydrocarbons and other oganic solvents. Marion E. McLean (National Bureau of Standards).

The thermal decomposition of acetaldehyde. F. O. Rice and Mary Thomas Murphy (Catholic University of America).

Synthesis in the poison-ivy field. Howard S. Mason (U. S. Public Health Service).

Physical chemistry, T. I. Taylor, *presiding*

The application of the ilkovic equation to quantitative polarography. Floyd Buckley and John K. Taylor (National Bureau of Standards).

Equilibrium constants of some reactions involved in the production of 1, 3-butadiene. F. G. Brickwedde, H. W. Woolley, and M. Moskow (National Bureau of Standards).

The thermodynamics and molecular vibration frequencies and internal rotation in propane. Kenneth Pitzer.

The separation and recovery of aromatic hydrocarbons from paraffins and naphthenes by adsorption. Beveridge J. Mair and Alphonse Forziati (National Bureau of Standards).

Obituaries

George Steiger, retired chief chemist of the U. S. Geological Survey, died in Washington, D. C., on April 18, 1944, after an illness of many months. Born in Columbia, Pa., on May 27, 1869, he was brought to Washington in early childhood by his parents. His primary education, obtained in the public schools of this city, was followed by attendance at Columbian College, now George Washington University, where he received the bachelor of science and master of science degrees in 1890 and 1892, respectively. In this latter year he joined the staff of the U. S. Geological Survey as a chemist. His work, in collaboration with and under the guidance of Dr. W. F. Hillebrand, produced a wealth of carefully prepared rock and mineral analyses and did much to standardize analytical procedure in inorganic chemistry. In 1916 he was made Chief Chemist and served in that position until 1930, when, upon his own request, he was relieved of the duties of administration in order to devote full time to research work in spectrography, which he continued until his retirement in 1939.

Until failing health in his later years forced upon him curtailment of physical activity, Steiger had been a devotee of pursuits that brought him in close contact with the woods and waters around Washington. Chief among these was boating. He was the proud owner of a houseboat and several motor-driven boats, which were berthed on the old Chesapeake and Ohio Canal and the Potomac River. A charter member of the Sycamore Island Boat Club, he was ever ready to tell of his experiences in camping and boating along the Potomac and the canal.

Mr. Steiger never married. His life was characterized by a simplicity that resolved itself into a philosophy of kindliness and gentleness, winning for him a host of friends both within and without his profession.

In addition to being a charter member of the Geological Society of Washington, founded in 1892, and a member of the American Chemical Society, for more than 50 years, he was a fellow of the Mineralogical Society of America and the American Association for the Advancement of Science. He was a member of the Washington Academy of Sciences, the American Institute of Mining and Metallurgical Engineers, and the Cosmos Club.

JOSEPH J. FAHEY.

ROGER CLARK WELLS, chief chemist of the U. S. Geological Survey, died unexpectedly on April 19, 1944, only a few hours after the death of George Steiger, retired chief chemist.

Dr. Wells was born at Peterboro, N. Y., on October 24, 1877, son of Byron Wells and Lucy (Clark) Wells. He graduated from Harvard in 1901 and received his doctorate there three years later, working on the atomic weights of sodium and of chlorine, under T. W. Richards. This early training in exact analytical chemistry is reflected in all his later analyses, all done with meticulous attention to accuracy. After holding instructorships at Harvard and Pennsylvania Universities, and serving a year as research chemist with the General Electric Co., he was appointed physical chemist on the Geological Survey in 1908, becoming chief chemist in 1930.

Probably because of his early work on the atomic weight of sodium, he always retained a strong interest in that element and became mineral resources specialist on soda and sodium compounds. Later, with R. E. Stevens, he developed methods for the separation and determination of the rare alkalies.

His contact with the mineralogical work of the Geological Survey evoked a strong interest in the chemical composition of minerals, especially those containing the less common elements, resulting in a number of difficult analyses of minerals of complex composition. The lead-uranium ratio in minerals, as an index of geologic age, fascinated him and for several decades he served on the National Research Council Committee on Measurement of Geologic Time, as well as on several other committees of the Council.

Dr. Wells was a member of many scientific societies, among them the Washington Academy of Sciences in which he served as vice-president in 1923 and 1938. He was president of both the Chemical and Geological Societies of Washington and a member and former elder of the Chevy Chase Presbyterian Church. In 1914 he married Etta May Card, of Syracuse, N. Y., who, with two sons, Arthur Byron and Roger Clark, survives him.

In recent years the administration of an increased chemical force, with urgent war demands for a greatly increased output, placed a heavy burden on Wells. Yet he remained the same kindly, cheerful, and conscientious leader, with no indication to his associates of the strain under which he was working. Ill but a week, his sudden death is a reflection of that strain.

W. T. SCHALLER.

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This JOURNAL, the official organ of the Washington Academy of Sciences, publishes: (1) Short original papers, written or communicated by members of the Academy; (2) proceedings and programs of meetings of the Academy and affiliated societies; (3) notes of events connected with the scientific life of Washington. The JOURNAL is issued monthly, on the fifteenth of each month. Volumes correspond to calendar years.

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JOURNAL
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VOLUME 34 NOVEMBER 15, 1944 No. 11

PALEOBOTANY.—*Temperate species in the Eocene flora of the southeastern United States.*[1] ROLAND W. BROWN, U. S. Geological Survey.

The Eocene flora of the southeastern United States, collected from sediments deposited along the ancient, coastal margin of the land, has been interpreted as a subtropical, chiefly strand, lagoon, and bayou flora. This conclusion is inferred from the character of its composition, which included types of ferns, palms, and dicotyledons, whose living counterparts or relatives are adapted to life at or near sea level in the tropics and subtropics. Roughly 80 per cent of the dicotyledons had leaves with entire margins, confirming, according to the Bailey and Sinnott (1915) formula, the interpretation based on composition. "There is not a single strictly temperate type in the whole assemblage," says Berry (1916, p. 136), "the nearest approach to such types being the genera *Juglans, Myrica, Magnolia, Cercis, Ilex, Nyssa,* and *Fraxinus.*

The purpose of this paper is not to dispute the general conclusion just stated but to call attention to some specimens that I believe have hitherto been misidentified and that may have originated from trees growing under temperate conditions inland from the coast, perhaps along streams in the foothills of the Eocene Appalachians. These relatively rare specimens include species of *Fagus, Sassafras,* and *Staphylea.* Other genera, with temperate rather than subtropical implications, are listed in the Eocene column of Table 7 in Cain's (1943) paper discussing the Tertiary aspect of the present temperate forests of the Great Smoky Mountains National Park. Many of these genera are represented only by fragmentary leaves, fruits, or seeds, and their identifications at best are largely conjectural. Of *Salix, Quercus* (except *Dryophyllum*), *Celtis,* and *Platanus* (of the *occidentalis* type) I find no authentic fossil record, and the leaf called *Cercis wilcoxiana* Berry represents *Cercidiphyllum arcticum* (Heer) Brown. The presence of *Cladrastis, Prunus, Ilex, Aralia,* and *Cornus* is, it seems to me, based on specimens that need further confirmation before they can be cited as reliable evidence of the existence of those genera in the Eocene flora of the southeastern States.

Despite these criticisms all the temperate genera listed by Cain were most likely present in the Eocene inland and upland forest. Their absence from the fossil record may be explained by their having lived on sites unfavorable to the preservation of their remains, and to the destruction of such remains before reaching suitable sedimentary basins near the coast. Even so, an occasional fortunate accident may have preserved a leaf or a seed that now awaits discovery by more thorough search of the fossil-bearing strata.

Whether a Tertiary flora may be adjudged subtropical or temperate depends upon a sane application of the assumption that, in general, Tertiary species had habitat and climatic requirements similar or nearly similar to their modern equivalents. The critical point here, of course, is the accurate determination of the existing equivalents, if any; for, even if fossils are correctly identified generically, the misidentification of their specific living equivalents may lead to erroneous conclusions as to habitat and climate. The modern North

[1] Published by permission of the Director, Geological Survey, U. S. Department of the Interior. Received June 19, 1944.

American correlatives of the fossil species about to be treated are wide-ranging in the temperate zone, but none reaches the Tropic of Cancer except species of *Acer*, *Carpinus*, and *Staphylea* at moderate to high altitudes in Mexico and Central America. These, however, can hardly be called indicative or representative of a subtropical climate in the ordinary sense.

In a previous paper (Brown, 1940, p. 351) I discussed *Acer knowltoni* (Berry) Brown from Eocene deposits near Somerville, Fayette County, Tenn. This maple is represented by asymmetric leaflets and characteristic samaras, which suggest comparison with the living boxelder maple, *Acer negundo* Linnaeus. Moreover, these fossils are associated with those hereinafter described as *Staphylea splendens* (Berry) Brown just as their living counterparts may be found associated today, thus strengthening the conviction that a maple of the *negundo* type is correctly identified as present in that Eocene flora. The absence of authentic Salicaceae and Betulaceae from the Eocene floras of the southeastern States would seem inexplicable if other predominantly temperate genera like *Acer*, *Sassafras*, and *Staphylea* were present. In 1942, however, in a collection made by F. S. MacNeil, of the U. S. Geological Survey, on the Taylor farm, Chester County, Tenn., I found well-preserved portions of betulaceous leaves having the pinnate secondary venation and the doubly serrate or serrulate margin characteristic of most Betulaceae. Examples of other missing temperate genera will doubtless be found as collectors become aware of the possibilities.

Fagus aspera (Berry) Brown, n. comb.

Diospyros asper Berry, U. S. Geol. Survey Prof. Paper 156: 127, pl. 25, fig. 32. 1930.

In 1937 I found several more specimens of the kind described by Berry as calyces of *Diospyros asper* at the same locality on Mill Creek, Hardeman County, Tenn. These fossils received the specific name *asper* because their outer surface is conspicuously roughened by pointed, short prickles or papillae. Although *D. asper* was compared with the calyces of *D. lanceolata* Roxburgh, from India, and with a fossil, *D. rugosa* Saporta, from the Oligocene of southeastern France, the comparisons upon closer inspection fail to be convincing. The rugosity of the living and fossil species cited consists chiefly of cross-wrinkles or striae and not of papillae. No living species of *Diospyros*, so far as I am aware, has calyces with papillose rugosity. On the other hand, the fossils can be matched very well with the 4-parted burs of *Fagus*.

Associated with these likely burs of *Fagus* are leaves hitherto called *Dryophyllum tennesseensis* Berry. There seems to be no doubt that these leaves belong to the Fagaceae, but they are sufficiently different from those of living species of *Fagus* to arouse caution before assigning them to that genus. The leaves, moreover, have been found abundantly at other localities where no burs of *Fagus* have yet been taken. Consequently, more exploration seems indicated before a conclusion can be reached as to the organic relationship of the leaves and burs.

Occurrence.—On Mill Creek, Hardeman County, Tenn.

Sassafras suspectum Brown, n. sp.

Sterculia wilcoxensis Berry, U. S. Geol. Survey Prof. Paper 156: 107, pl. 26; pl. 27, fig. 5 [not other references]. 1930.

The leaves referred to here, described and illustrated by Berry, despite general resemblances seem to me to differ in important respects from the remainder hitherto synonymized with *Sterculia wilcoxensis*. The latter have wide, open sinuses between the relatively narrow, pointed lobes, and the midveins of the lateral lobes display a tendency to spread away from rather than to converge toward the apex. I can match the former easily by leaves from *Sassafras;* but I know of no living leaves that compare readily with the latter. If these also are *Sassafras* they should be kept distinct from the former.

These leaves are somewhat larger than those of the Tertiary species described from the northwestern States. In general appearance they also resemble some leaves of *Artocarpus pungens* (Lesquereux) Hollick, but the lobes of the latter are sharp-pointed.

Occurrence.—Railroad cut at Pine Top, Hardeman County, Tenn.

Staphylea splendens (Berry) Brown, n. comb.

Euonymus splendens Berry, U. S. Geol. Survey Prof. Paper 91: 267, pl. 61, fig. 6; pl. 62, figs. 1–5. 1916.

Hicoria crescentia Knowlton. Berry, U. S. Geol. Survey Prof. Paper 156: 59, pl. 34, figs. 1–5. 1930.

The first specimens described as *Euonymus splendens* were single detached leaves which aroused no suspicions of their being leaflets, although the describer noted that they were slightly inequilateral and bore some resemblance to *Hicoria antiquorum* (Newberry) Knowlton. In 1930, Berry reported compound leaves from Somerville, Tenn., as *Hicoria crescentia* Knowlton, on the basis of resemblance to a very fragmentary specimen described by Knowlton from Eocene strata in Yellowstone National Park. Whether Knowlton's specimen was correctly identified even generically is a moot question, but the leaflets of the Berry specimens of both species, as may be seen by comparing the illustrations, resemble one another so closely that I venture to believe they represent but one species.

In 1937 I visited Grand Junction and Somerville, Tenn., the chief localities from which the Berry specimens came and made collections containing additional material which convinces me that these specimens need reallocation. The outstanding facts about the compound leaves are that all are trifoliate, and all the leaflets have relatively long petiolules. Neither of these facts harmonizes with the assignment of the leaves to *Euonymus* or *Hicoria*, but they are consonant with an interpretation as *Staphylea*.

Unfortunately, none of the characteristic bladdery pods of *Staphylea* has yet been found in the Tennessee localities to confirm this identification. Collectors should be on the alert for them.

This species resembles closely *Staphylea acuminata* Lesquereux (1878, p. 267, pl. 48, figs. 4, 5) from the lake beds at Florissant, Colo., but in the Florissant specimens the petiolules of the side leaflets are very short, thus harmonizing more closely with the existing species, *S. trifolia* Linnaeus, of the eastern United States.

In general form, venation, and marginal dentition these leaves are similar to some called *Euonymus glandiferus* Ball (1931, p. 85, pl. 6, figs. 1, 2, 4; pl. 7, fig. 1) from the Indio formation of Texas. The latter, however, differ uniquely in having prominent glands in the angles made by the secondary veins with the midvein and about 5 mm from the midvein. At present I have no opinion as to the propriety of assigning the Indio specimens to *Euonymus*.

Occurrence.—One mile north of Somerville, Fayette County, Tenn.; one mile south of Grand Junction, Hardeman County, Tenn.

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MYCOLOGY.—*"Oedema," or "wart," of cultivated violet identified as scab.*[1] ANNA E. JENKINS, Bureau of Plant Industry, Soils, and Agricultural Engineering.[2,3]

This article reports the recent identification of "oedema," or "wart," of violet (*Viola odorata* L.) as the *Sphaceloma* disease now known as scab of violet (*11*). The work has involved historical research that has led to a better orientation of the almost unknown account of the "oedema," or "wart," published in 1899, as well as to a more complete documentation of what appears to be the only representative specimen. The existence of these early records was ascertained in 1932, during a preliminary study (*12*) of the scab. At that time, however, material was insufficient to permit the tracing of this fungus malady to the "oedema." As the name connotes, this was thought to be of physiologic origin. Recently, when it became a question of identifying the "oedema" as scab, ample material of the scab was available for comparison. Assembled from various places and representing the disease on wild, as well as cultivated, violet (*10, 11*), these specimens show the range of symptoms that may be exhibited by this highly disfiguring and destructive disease.

[1] Received July 12, 1944.

[2] This paper was presented at the meeting of the Potomac Branch of the American Phytopathological Society held at the Plant Industry Station, Beltsville, Md., on February 23–24, 1944. The abstract will be published in Phytopathology.

[3] Certain historical facts reported in this article, not available from other sources, were obtained over a period of years in various personal conferences with Drs. B. T. Galloway and A. F. Woods and Messrs. W. E. Taylor, David Bissett, and J. W. Byrnes as former or present members of the U. S. Department of Agriculture. During the period with which this paper deals, Dr. Galloway was chief of the Division of Vegetable Pathology, renamed in 1895 (*4*, p. 169) the Division of Vegetable Physiology and Pathology (*16*). Dr. Woods joined Dr. Galloway's staff as physiologist in 1893 (*16*). In the same year Mr. Taylor entered the division as Dr. Galloway's clerical assistant. The two greenhouse floriculturists, Messrs. Bissett and Byrnes, in 1904 and 1906, respectively, became members of the Bureau of Plant Industry in which the "Department's work on plants was consolidated" in 1901 (*15*, p. 197) with Galloway as chief. It is a pleasure to acknowledge here the helpful assistance freely given at one time or another during the present study by all those mentioned. It is proper to mention that Dr. Woods was in attendance during the morning session, February 23, when this paper was presented.

The account of the oedema now comes to the fore not only as the first known record of violet scab, but also as one of the few *Sphaceloma* diseases encountered in the United States during the early phytopathological period. It may be stated, then, that through the effort herein recorded another advance has been made in the reconstruction of the history of plant diseases caused by *Sphaceloma*. This paper elaborates upon an aspect of early pathological history emanating from the U. S. Department of Agriculture, although barely apparent in its annals.

HISTORICAL BACKGROUND

Extraordinary interest in violets at the turn of the century is expressed in the separate section entitled "Violets" in Dr. Galloway's first annual report as chief of the Bureau of Plant Industry (*6*, p. 89, also see *14*). The pertinent passage from Galloway is quoted as follows:

> As a result of the demand for the violet and the price which it commands in the market, nearly every person interested in a general supply of cut flowers, grows or attempts to grow violets, while many others make violet culture their specialty and main dependence. In consequence of the many failures which are annually reported in this line, the work of the Experimental Gardens and Grounds has been extended to include a test of methods of culture and varieties of violets best suited to commercial growing. As a beginning in this direction two houses have been erected and so arranged that the various conditions of soil, heat, and moisture demanded by the violet can be studied. A variety collection, comprising all of the commercial sorts of both the United States and Europe, has been brought together for the purpose of determining their fitness for commercial work and their value as parent stock for new varieties.

Throughout his earlier chiefship of the phytopathological division already named, Dr. Galloway was actively concerned with diseases of violets grown under glass. This is shown by brief mention of the subject in most of his annual reports for the period, viz., 1890–1900.

Investigations of violet diseases were car-

ried out by the division not only in the laboratory and "Department greenhouse" (*cf. 3*, p. 11), but also in certain violet houses at Garrett Park, Montgomery County, Md.[4] (*cf. 3*, p. 11). These were built about 1894–95 by Dr. Galloway and P. H. Dorsett[5] and were privately owned and operated by them until about 1898; thereafter solely by Dorsett. At Dorsett's request about 1900 the violet houses were purchased by Mr. Bissett. He had received exceptional training in floriculture and had had wide experience in violet culture. In part, the original violet houses were destroyed by fire about 1904 (*7*, p. 237); Mr. Bissett constructed others, again in Garrett Park, and there continued with his specialty until about 1930. The blooms produced in his houses commanded the highest prices in large city markets and members of the Bureau familiar with the work still attest to their exceptional beauty, size, and fragrance. He has been, therefore, deservedly regarded as one of the most outstanding specialists in violet culture.

GALLOWAY'S TREATISE ON VIOLET CULTURE

Galloway's book on *Commercial violet culture*, published in three editions (*5*), commemorates his and Dorsett's experience in growing violets under glass. To quote from the preface to the first edition (*5*, 1899):

"I wish to express my thanks to Mr. P. H. Dorsett, who shared with me all the trials and vexations which fall to the lot of the beginners in this work. He is now a successful grower and many of the illustrations given are from his houses."

The numerous illustrations (61 halftones) in the first edition are reproductions from photographs made by Mr. Dorsett, as Messrs. Bissett, Byrnes, and Taylor affirm. This explains the source of the photograph of the "oedema," or "wart," to be mentioned later.

The book does not mention the location of the violet houses, but this is known to have been at Garrett Park, as already indicated. This is definitely mentioned by Galloway in his separate article already cited (*7*), in which he specifies that the varieties grown at Garrett Park were chiefly Lady Hume Campbell and to a lesser extent Marie Louise.

Chapter 8, or nearly one-fourth of the text, deals with "Diseases and Insect Enemies." This chapter embodies the investigations of the trio of scientific workers, Galloway, Dorsett, and Woods, as Dr. Woods has verified and as may be deduced from Galloway's direct reference to "Messrs. Albert F. Woods and P. H. Dorsett, who have been associated with the writer in work on plants under glass. . . ."

THE "OEDEMA"

The account of the "oedema," or "wart," with which this article is particularly concerned, is precisely the same in all three editions of Galloway's *Commercial violet culture* (*5*, ed. 1, pp. 182–185, fig. 55; ed. 2, pp. 186–188, fig. 57; ed. 3, pp. 193–194, fig. 59). Coon's *Practical violet culture* (*2*) is essentially a successor to this early treatise by Galloway and admittedly draws heavily upon it. But there is here no direct reference to the "oedema" in the much reduced discussion corresponding to Galloway's chapter 8. Gregory and Davis's (*9*) mention of "oedema" or "dropsy" clearly is taken from Galloway.

The section on "oedema" in Galloway's book is here quoted in full:

Oedema, or Wart Disease. This trouble often proves quite serious, but is easily kept under control by the proper handling of the plants. The affected plants show wart-like growths over the leaves, and these are usually of a brownish color. These warty growths vary in size, some of them being quite small and others one-eighth of an inch long and one-sixteenth of an inch high. The corky growths are not confined wholly to the leaves. In fact, they frequently occur on the leaf stalks, and sometimes on the flower stalks also. It is found that where these warty formations are developed the whole leaf is in a peculiar condition. It is brittle, and when taken in the hand cracks very easily. The leaves, in other words, instead of having a live, elastic feel, appear to the touch to be dry like a shaving, and when bent will break with a cracking noise. Wherever a break of this kind occurs the corky growth appears in time. The corky formations may also develop wherever an

[4] Garrett Park is in the Rock Creek Valley, about 12 miles northwest of the District of Columbia.

[5] Mr. Dorsett was a member of Dr. Galloway's early phytopathological staff (*16*).

insect punctures the leaves. The punctures of aphides and the bites of spiders cause many of these swellings. When the plants get into this condition it is practically unfit for flowering, and when badly diseased it is very difficult to ever get it into proper shape again. The trouble is one that is brought on gradually by improper relations between the moisture of the soil, moisture of the air, and the light.

Where plants are mulched and the soil kept constantly wet the trouble is likely to follow, especially if heavy shading is adopted. Where the plant is grown for some time under these conditions all of its tissues get into a dropsical or oedemic state, and it needs only an injury of some kind to cause the formation of the wart-like growths. If the conditions are very favorable, injuries are not necessary for the wart-like growths, as they will be produced by the plant without intervention of anything of this kind. This is due to the fact that the plant is really making an abnormal effort at growth, and the warts are nothing more than excessive growth of the cells at particular points. This trouble seldom occurs in houses properly lighted and ventilated. In underground pits, and in outdoor frames where heavy shading is used, it is apt to occur, especially if the practice of mulching is adopted.

By paying proper attention to light, ventilation, and watering, little or no difficulty is experienced from the trouble. In case it is seen that plants are becoming oedemic it will be necessary to modify at once the surroundings to such an extent as to admit more light to the leaves and more air to the soil. It will not do, however, to bring about these changes too rapidly. Light should be gradually given, and the amount of water added to the soil should be slowly diminished. If the change is too abrupt, serious consequences may result, as the plant, having been grown under such abnormal conditions, is not able to withstand the unusual exposure to bright light and dry soil, which the sudden change might bring about.

Bearing the legend "oedema, or wart disease," an accompanying illustration, unfortunately indistinctly reproduced, represents the lower surface of a fresh, severely diseased leaf blade. Careful comparison reveals that the illustration corresponds so closely to the leaves of the specimen of the "oedema" mentioned in the introduction of the present paper (Fig. 1, *D*) that it could well represent them, i.e., when freshly gathered.

This historic specimen, undated and without a formal label, was included among the physiological specimens of the Mycological Collections of what is now the Bureau of Plant Industry, Soils, and Agricultural Engineering. It consists of several more or less broken leaves, together with numerous leaf fragments (Fig. 1, *D*, *a–d*). These leaves are definitely those of *Viola odorata*.[6] On a slip of paper within the packet is written in Dr. Galloway's hand:[7] "Soft or brown spot, Garrett Park." Penciled on the outside of the packet appears: "Called wart . . . may follow insect bites."[8] The name "oedema," which does not appear on the specimen, was original with Dr. Woods, as he has explained to the writer. In lieu of the exact date of collection, it seems reasonable to assume that it was between the years 1897–99: By 1897 a violet crop had been harvested as shown by Galloway's encouraging statement of the price received for blooms of the variety Lady Hume Campbell during the 8-month period October 1897–May 1898 (*5*, ed. 1, p. 223; ed. 2, p. 232; ed. 3, pp. 256–257); by 1899 Galloway's book was published, and, as indicated by the preface to the first edition, he was no longer connected with the violet-growing venture at Garrett Park.

Among the trio, Galloway, Dorsett, and Woods, it befell Dr. Woods as physiologist to take the lead with respect to the "oedema" as it appeared in the violet house at Garrett Park. The serious problem confronting them was to determine practical means of holding the diease in check. This Dr. Woods accomplished, and investigation into the cause of the disease was not pursued further.

Since the autumn of 1932, when violet scab first came to the attention of Massey, White, and Jenkins (*12*) through an outbreak of the disease in field plantings in Pennsylvania and New York, it has been found that the disease is more or less generally distributed throughout the District of Columbia area and not only at Garrett Park. This is shown by herbarium specimens presented in Fig. 1, *A*, which illustrates the disease on *Viola odorata* from a garden in Arlington, Va. (Fig. 1, *A*, *a*); on a wild

[6] Verification kindly made by Dr. S. F. Blake, Division of Plant Introduction and Exploration, Plant Industry Station, Beltsville, Md.

[7] Handwriting verified by Dr. Woods.

[8] Handwriting of Mrs. F. W. Patterson, who joined Dr. Galloway's staff in 1895 (*8*).

violet hybrid (*V. affinis* Le Conte×*V. papilionacea* Pursh) growing naturally in a glade in Rock Creek Park, Md. (Fig. 1, *A*, *b*), and on blue marsh violet (*V. cucullata* Ait.) from the District of Columbia (Fig. 1, *A*, *c*). Norton's (*13*, p. 117) report of an unidentified disease of violet in Maryland (place undesignated) in 1909 suggests a stil

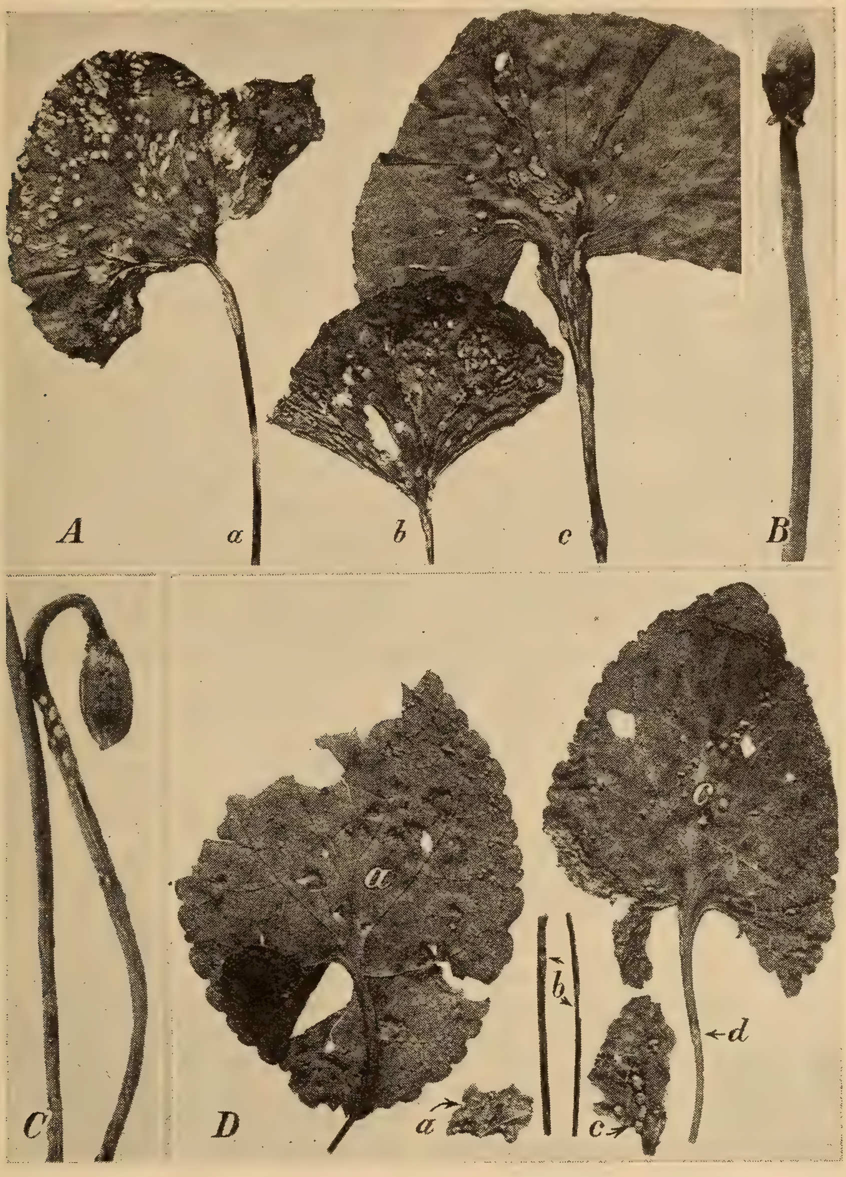

FIG. 1.—*A*, Dry pressed specimens of scab of violet representing gatherings made in the open in the District of Columbia area: *a*, sweet violet, upper leaf surface, from a garden in Arlington, Va., October 24, 1941, N. Rex Hunt; *b*, wild violet hybrid, folded parts of leaf representing lower leaf surface, Rock Creek Park, Md., October 12, 1935, J. A. Stevenson; *c*, lower leaf surface of blue marsh violet from a garden, District of Columbia, October 7, 1939, A. E. Jenkins. *B* and *C*, Fresh infected blossom stalks and capsules from same source as *A*, *c*, October 16, 1935, W. T. Swingle. *D*, "Oedema" of sweet violet: *a*, lower leaf surface; *b*, lesions on petioles; *c*, upper leaf surface; *d*, single lesion on petiole, Garrett Park, Md., 1897–1899 (see explanation in text), B. T. Galloway. All natural size. Photographs *A* and *D* by R. L. Taylor and *B* and *C* by M. L. F. Foubert.

earlier record of violet scab. Thus it reads: "Watery pimples on leaf R [symbol for 'rare'], cause (?), perhaps insect."

In the autumn of 1932, the only fresh material of scab of violet that the writer had seen consisted of diseased specimens of cultivated violet, variety Freys Fragrant, from Pennsylvania (*11*, p. 1 and pl. 1, *A–D*, and pl. 2, *A–D*, *E*, and *F*). At that time the same gathering of fresh specimens obtained for the purpose were shown to Dr. Galloway and then to Mr. Bissett, and later described to Dr. Woods. Still more recently Dr. Woods has been shown the published illustrations just cited as well as herbarium specimens. Upon seeing the specimens Dr. Galloway turned to the illustration of "oedema" in his book, but he was not certain that this was the disease affecting the violets from Pennsylvania. At the moment he could not recall that the "oedema" affected other organs of the plant than leaves. The writer remarked that, since the disease of Freys Fragrant was caused by *Sphaceloma*, it should resemble anthracnose of grape caused by a fungus of the same genus. Galloway, who was thoroughly conversant with this grape disease, then observed that, actually, the symptoms of the "oedema" resembled those of grape anthracnose.

From the writer's description of the scab on Freys Fragrant, Dr. Woods did not recognize this disease as the same as that he had known as "oedema." More recently, when he saw specimens of the disease on Freys Fragrant, he still found it different in appearance from the "oedema" he had known at Garrett Park, i.e., as illustrated in Galloway's book. Dr. Woods and the writer reviewed various specimens of violet scab, such as those here illustrated (Fig. 1, *A–C*), and finally concluded that the marked difference in the leaf spot on Freys Fragrant as compared with that of the "oedema" might be explained on the basis of the reaction of the two different sweet violet varieties to infection by the *Sphaceloma*. No physiological disturbance that might truly be called oedema was known to Dr. Woods, and none has been found by the writer in the literature on violet diseases.

On Freys Fragrant initial infection often occurs on the lower leaf surface, thus accounting for the leaf spot being generally more conspicuous on that side of the leaf. Violet scab blade lesions may be surrounded by a deep green border and this is particularly noticeable on the flattened to moderately bulged Freys Fragrant leaf spot (*11*, pl. 1, *D*, and pl. 2, *F*). The Galloway specimen, shows numerous raised, hyperplastic lesions on the upper surface, together with occasional vein lesions, and two vein lesions are distinguishable near the base of the blade illustrated by Galloway. Among the three leaves illustrated in Fig. 1, *A*, the third (*c*) shows lesions practically limited to the veins below. Clearly, this infection originated on the lower leaf surface, where the symptoms are the more prominent. Similarly, on the leaf illustrated in Fig. 1, *A*, *b*, where the lesions are chiefly interveinal, initial infection was correspondingly limited to the lower leaf surface. Inspection of the leaf of *Viola odorata* shown in Fig. 1, *A*, *a*, as well as of other leaves from the same source, reveals that initial infection must have taken place on both blade surfaces: thus there are lesions of equal prominence and appearance on either side of the leaf.

Returning to the Galloway specimen and the representative illustration, it may be discerned that the more prominent lesions evidently represent infection on the upper leaf surface. A similar instance of leaf spots bulged below and raised above resulted in the case of a related disease, namely, lima bean scab, when leaves were artificially inoculated with the pathogene of that disease (*1*, Fig. 1, *A*, *B*). In artificial inoculations on leaves of the variety Princess Mary these proved to be more susceptible to infection on the lower, rather than the upper blade surface (*11*, p. 8, pl. 4, *A*). The culture used as inoculum was from violets, probably of the variety Mrs. David Lloyd George, grown on the Hudson, i.e., at Rhinebeck, N. Y.

Among all those who saw the fresh severely diseased specimens of Freys Fragrant in 1932, Mr. Bissett was the only one to whom the disease was familiar. With his broad knowledge of violets he at once named the particular variety and as quickly

recognized the malady. Essentially, his statement was as follows:

"The disease is what has been called 'oedema.' Stems and blossom stalks, as well as leaves, may be affected. When the trouble is present, cultural conditions are unfavorable. Cold, too much moisture, and poor ventilation are environmental conditions favorable to the disease. I have received specimens from various places; once I took a specimen to Dr. E. F. Smith, who told me that the disease was caused by a fungus."

More recently, Mr. Bissett has stated that when Galloway and Dorsett were contending with the "oedema" at Garrett Park, violet growers on the Hudson also were having to deal with it. He offered the further information that when he acquired the violet houses at Garrett Park he removed the partitions, thus improving air circulation, and exercised particular care to keep the plants dry, and in this way completely eliminated the disease. Mr. Bissett stated also that he had observed the "oedema" on wild violets in a woodland near Garrett Park.

In critical examinations of *Sphaceloma violae* Jenkins, as the pathogen of violet scab is designated (*11*, p. 7), the writer has found it more satisfactory to examine petiole rather than blade lesions for hyphal fragments, stromata, and also conidia. Following this plan in the examination of the Galloway specimen, microscopic preparations were made from scrapings from the delicate petiole lesions (Fig. 1, *D*, *b* and *d*). A few hyphal fragments, together with a number of conidia recognizable as of the *Sphaceloma*, were found in these mounts.

A summary of the known distribution of violet scab (*10*) shows that the disease now has been found in this country in all coastal states from Massachusetts to Texas, except Delaware[9]; outside the United States its known geographic range includes New South Wales in Australia, and the Union of South Africa, in Africa.

[9] The presence of violet scab in Louisiana was ascertained when Dr. M. A. Petty, formerly of the Southwestern Louisiana Institute, Lafayette, La., remarked upon seeing illustrations that he was familiar with this same disease as affecting wild violet on the horticultural farm of the Institute. Specimens had been collected a number of times during class excursions, he said, but remained unidentified.

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MYCOLOGY.—*The fungus genus* Cheiromyces, *with description of a new species.*[1] G. W. Martin, State University of Iowa.

Some pieces of oak bark collected in Iowa City and placed dry in a sterile Petri dish on August 17, 1943, were moistened on November 20. Late in December numerous small black sporodochia were observed to have developed, which appeared to belong to a species of *Cheiromyces.* Attempts to determine the species led to a realization of the uncertainty that exists concerning this genus.

Cheiromyces has a curious history. It was first mentioned quite casually in a footnote on page 312 of Berkeley's *Cryptogamic botany* (1857). On the following page crude drawings are reproduced of *C. stellatus* B. & C. from specimens on *Scirpus eriophorus* sent from Pennsylvania by Michener. No formal description is given, but it is clear that the fungus bore its spores on a sporodochium, that the hyphae were dark, and that the spores were composed of two to four parallel digits arising from a common base. No septa are shown in the spores, but it is difficult to conceive of such spores without septa. Eighteen years later (Grevillea **3**: 97. 1875) a brief diagnosis of the genus and species (the specific name misspelled *stillatus*) was published, with citation of the earlier mention in the *Cryptogamic botany.* In addition to the collection from Pennsylvania, another one from Alabama, by Beaumont, is recorded, apparently on the same substratum, with the added comment "On a *Sphaeropsis*," which presumably applies to both.

The Alabama collection may be the source of the material distributed by Curtis as *C. beaumontii* B. & C. The latter name was apparently never validly published, and doubt has been expressed as to whether it is conspecific or even congeneric with the material to which the name *C. stellatus* was first applied. Saccardo, however (Sylloge **4**: 554. 1886), cites it as a synonym.

Peck (Bot. Gaz. **5**: 35. 1880) described a second species, *C. tinctus,* from Vermont. He states that in external appearance it closely resembles "*C. beaumontii* B. & C., of which Dr. Curtis distributed specimens but of which I have seen no description. In it the spores are smaller, of a brown color and destitute of septa." The spores of *C. tinctus* are described as having 2 to 5 divisions, these 1–3-septate and tinged with blue, 12.5–18μ in length. In compiling this and the preceding species Saccardo lists the genus under the Dematiaceae but notes: "Ad Tubercularieas nutat."

Two additional species were added to the genus. *C. comatus* Ell. & Everh. (Proc. Acad. Nat. Sci. Philadelphia **1893**: 171) was described from *Azalea* twigs in New Jersey and *C. speiroides* Höhn. (Ann. Myc. **1**: 408. 1903), from coniferous wood in lower Austria. Also, Ellis distributed material as *C. beaumontii* B. & C. on *Acer* and *Pyrus* in N. A. Fungi 762, with the note: "Sec. to specc. in herb. Curtis."

Höhnel's description is very full and precise. The spores of his fungus are septate, commonly 6-celled, and attached at one of the central cells, after which the two ends bend upward so that they are more or less parallel. He discusses the previous species and transfers *C. comatus* to *Exosporium.* Later (Sitzb. Akad. Wiss. Wien, math.-nat. Kl., Abt. I, **119**: 664. 1910), he reviewed the entire genus. He states that the fungus is no longer present on the type material of *C. stellatus* at Kew but decides, on the basis of Berkeley's figure, that the spores are unseptate. He is convinced that *C. beaumontii* B. & C. is not a synonym of *stellatus,* as had been supposed, but is not only specifically but generically distinct. He therefore erects for it the genus *Cheiroconium,* which he assigns to the Melanconiaceae and states that he does not doubt that *C. tinctus* Peck is the same species. His own *C. speiroides* he removes from *Cheiromyces* on the basis of the multicellular spores and the pale or hyaline hyphae of the stromatic base, erecting for it the new genus *Cheiromycella,* suggesting that *Speira inops* Bomm. Rouss. & Sacc. may also be included. This reduces *Cheiromyces* to Berkeley's original and somewhat uncertain species as reported in 1857.

Examination of the material distributed by Ellis as *C. beaumontii* in N. A. Fungi 762

[1] Received July 6, 1944.

suggests that if this is really the same as the specimen from Alabama originally sent to Berkeley by Beaumont, Höhnel is correct in removing it from *Cheiromyces*. It is at least equally probable, however, that the Ellis collections represent an entirely different fungus. On the basis of Peck's description, it may be doubted whether *C. tinctus* is the same, particularly as Peck implies that he had seen *C. beaumontii* as distributed by Curtis.

Dr. G. R. Bisby has been kind enough to examine the material of *C. stellatus* in the Kew Herbarium and found a brown septate body that may represent a spore or part of a spore of the *Cheiromyces*, although he adds "no trust can be placed in it." He found several spores of *C.* "*beaumontii*," the second collection later assigned by Berkeley to *C. stellatus*. These are brown, digitate, and septate, although Berkeley's drawings on the cover depict it as without septa and correspond in all essential respects with the drawings made from Michener's Pennsylvania collection. We are therefore justified in assuming that the spores of the original collection were also brown and septate.

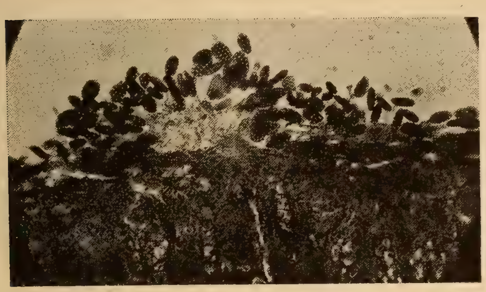


Fig. 1.—*Cheiromyces digitatus* n. sp. Photomicrograph of section through acervulus, ×300.

There still remains to be considered the question as to whether *Cheiromyces* is distinct from *Speira* and *Dictyosporium*. Lindau (in Rabenh. Krypt.—Fl. **9**: 163. 1910) places both the latter genera in his subsection Coniothecieae, lacking differentiated conidiophores. Berlese's illustration of *Speira toruloides* Corda, reproduced on page 198, shows spores strongly suggesting those of the Iowa fungus although somewhat larger. The distinction between the two genera is that in *Dictyosporium* the

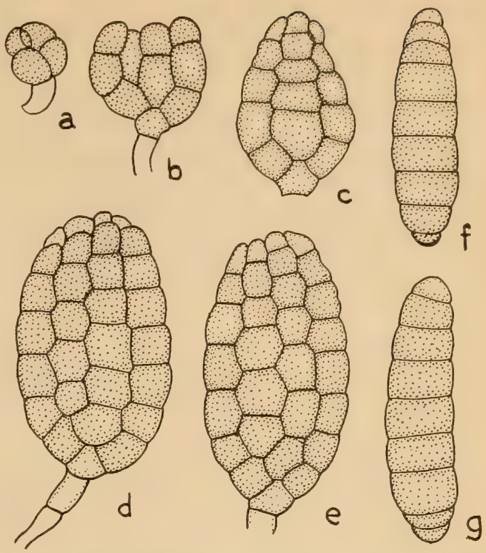


Fig. 2.—*Cheiromyces digitatus*, n. sp. Spores: *a–c*, Successive stages in development; *d*, *e*, mature spores, as seen in face view; *f*, *g*, same, seen from side. All ×1,000.

conidial chains remain together, while in *Speira* they tend to separate. Guéguen (Bull. Soc. Myc. France **21**: 98. 1905) denies that this is a valid generic distinction. Incidentally, Lindau cites *Botryosporium* Schw. 1832 as a synonym of *Speira* Corda 1837. If the two are synonyms, then Schweinitz's name is valid, but only reference to the latter's specimen can decide that point. In the present instance, however, the constant occurrence of a definite sporodochium in the *Cheiromyces* and the complete lack of any suggestion of separation of the filaments making up the compound spore seem to warrant recognizing Berkeley's genus and assigning it to the section Dictyosporae of the Tuberculariaceae, among the dark-spored genera. Since the Iowa collection seems clearly distinct from Berkeley's species, it is described as new.

Cheiromyces digitatus, n. sp.

Epixylo, superficiali; sporodochiis pulvinatis, atris, minutissimis, 0.2–0.3 mm latis, ex hyphis hyalinis dense compositis, strato conidiorum tectis; conidiis nigro-olivaceis, multicellularibus, planis, e cellulis adnatis, in ordinibus 3–4(–5) longitudinalibus instructis, 27–39 ×15–22 ×6–10μ.

Sporodochia pulvinate, circular or elliptical in outline, 0.2–0.3 mm in diameter, sometimes

anastomosing longitudinally, black, often hoary at surface; substance composed of obscurely filamentous, septate, gelatinized hyphae mostly 3–4μ in diameter, bearing spores at their tips; conidia dark olivaceous, composed of mostly 4, less commonly 3, rarely 5 rows of cells closely appressed in a single plane, arising from a basal cell, each row 3–7-septate, the basal cell somewhat and the terminal cells distinctly paler than the others, 27–39 × 15–22μ in face view, 6–10μ thick.

On oak bark in moist chamber, Iowa City, Iowa, December, 1943. *G. W. Martin* 4921, type.

As may be seen from the illustration, especially Fig. 2, *a–c*, the development of the spores of *C. digitatus* is fundamentally different from the process as described by Höhnel for *C. speiroides*. It seems probable, therefore, that his removal of the latter species to his new genus *Cheiromycella* is justified, although for a reason different from that originally stated.

ZOOLOGY.—*Notes on Mexican snakes from Oaxaca.*[1]

By Angus M. Woodbury and Dixon M. Woodbury, University of Utah. (Communicated by Herbert Friedmann.)

This paper is a report of studies made of 136 specimens of snakes of 25 species in the herpetological collection of the University of Utah obtained from Wilbur Barker who reports that they were collected from the general vicinity of Tehuantepec, Oaxaca, Mexico, on the Isthmus of Tehuantepec. According to notes of field collections, most of them come from places in or near the city, but a few specimens are reported from areas 10 or 15 miles away. These notes have also been useful in helping to elucidate the habitats occupied.

We are greatly indebted to Dr. Hobart M. Smith for advice during the progress of the study and for his comments and criticism of our views of the problems. All colors are referred to the *Dictionary of color* by Maerz and Paul.

Leptotyphlops phenops phenops (Cope)

Six specimens, usually found under litter. They show unusually high total scale counts. The rostral is white dorsally and is completely separated from the supraoculars by the nasals. The scales usually have dark brown centers, which become lighter ventrally and in some cases become indistinguishable from the edges. The scale edges are light brown, sometimes giving a whitish aspect. Dorsally the dark centers tend to connect in longitudinal series to form seven dark stripes which usually have a beaded appearance due to the narrow connections between the dark centers. The tail beyond the end of the stripes is black above and is white below for half or two-thirds of its length, the white involving the tip.

Scalation of 5 specimens: Total scales from rostral to tip of tail 251, 256, 261, 265, 277; subcaudals 19, 18, 19, 17, 17; longitudinal scale rows 14.

Measurements: Total length 76, 155, 81, 195, 171 mm; tail length 5, 8, 5, 10, 8 mm.; ratio of tail to total length 6.6, 5.2, 6.2, 5.1, 4.7 per cent.

Loxocemus bicolor bicolor Cope

Light-chinned American Python

Five specimens (UU 2507 ♂, 2522 ♂, 2707 ♂, 2718 ♀, 2800 ♂) from wooded areas containing fallen logs, leaf litter, and loose soil, where it is usually concealed in the litter, under logs, or behind the bark. According to the collector's notes, the two forms of *Loxocemus* are found in the same habitat.

The dorsal color is a dark brown, darkest on the head; the ventral is light gray with slight variations. Details of color and scalation will be discussed under *L. b. sumichrasti.*

Loxocemus bicolor sumichrasti Bocourt

Dark-chinned American Python

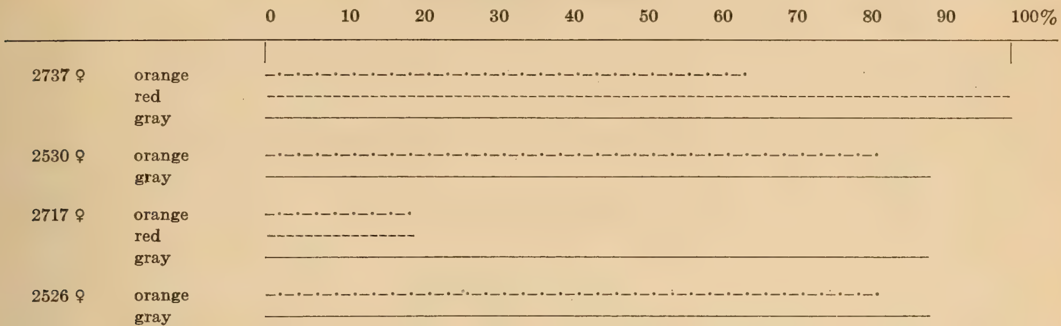
Four specimens (UU 2526 ♀, 2530 ♀, 2717 ♀, 2737 ♀) from the same habitat where *L. b. bicolor* was found. The dorsal color is essentially alike in the two forms, but differences occur on the ventral surface. These colors are analyzed quantitatively as well as qualitatively in the following table, which is based upon the *Dictionary of color*, by Maerz and Paul, 1930. This shows for the dorsal, ventral, and chin colors for each specimen the Maerz and Paul number in the dictionary and the components of the inks used to produce those colors as sorted out

[1] Received April 24, 1944.

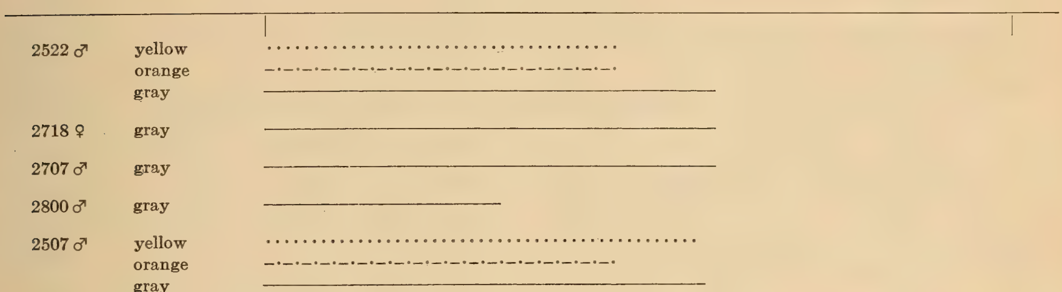
and translated into percentage in the various columns. These percentages are based upon the gradations used in the dictionary to produce the various hues and thus represent quantitative measurements of the colors of the snakes in terms of the colors found in the dictionary.

Abdominal Color

Loxocemus bicolor sumichrasti

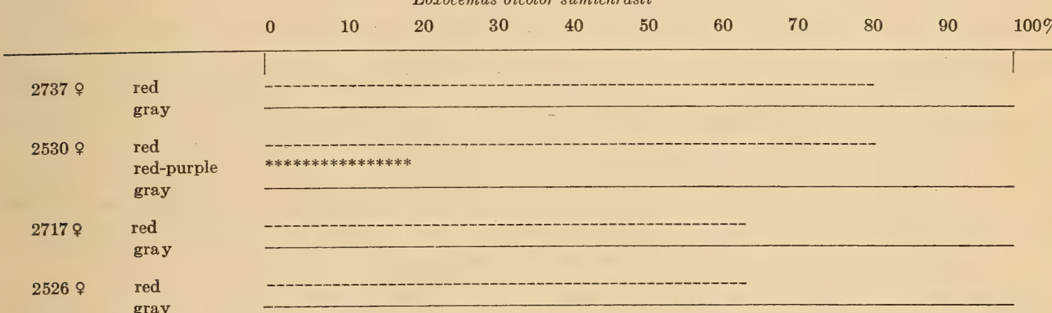


Loxocemus bicolor bicolor

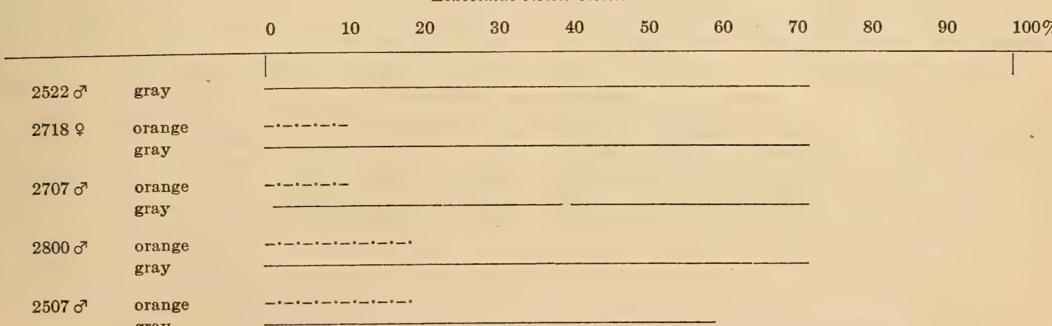


Chin Color

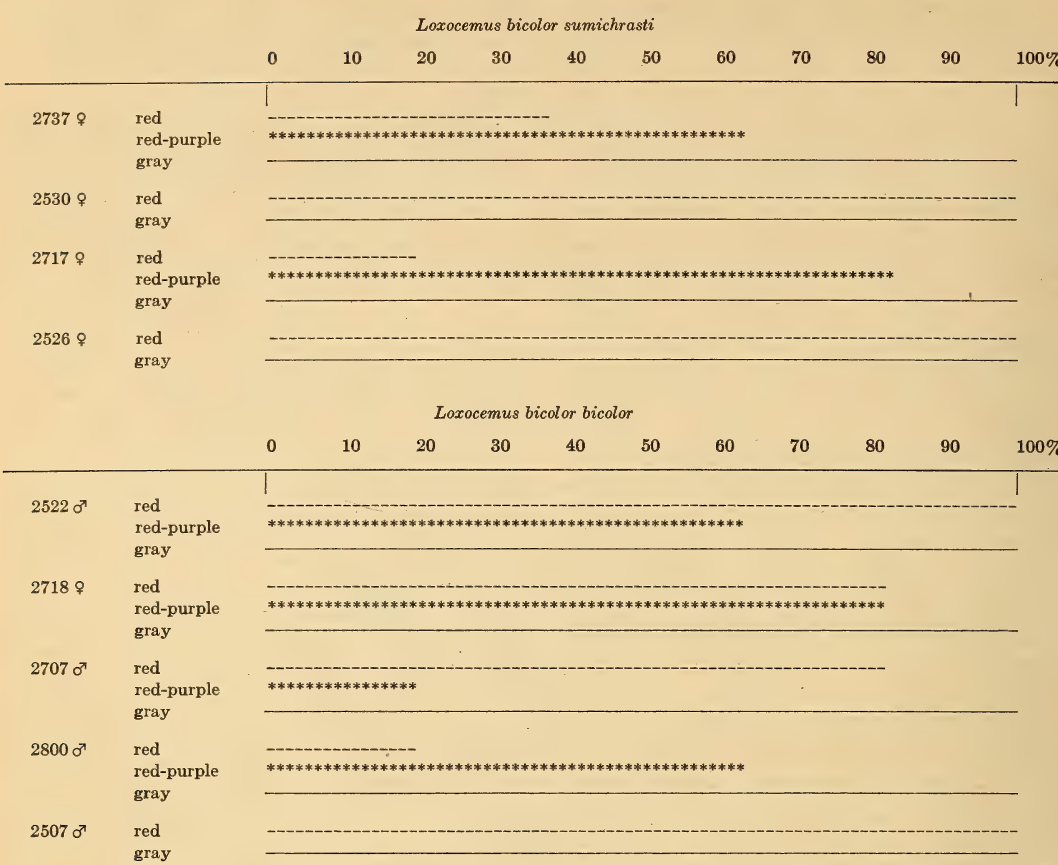
Loxocemus bicolor sumichrasti



Loxocemus bicolor bicolor



Dorsal Color



Nos.	Dorsal color				Abdominal color					Chin color					
	M & P No.	Per cent of color			M & P No.	Per cent of color				M & P No.	Per cent of color				
		Gray	Red	Red-purple		Gray	Red	Orange	Yellow		Gray	Red	Red-purple	Orange	Yellow
Loxocemus bicolor bicolor															
2507 ♂	8L1	100	100	0	13G6	57	0	45	55	13A3	57	0	0	18	0
2522 ♂	8H4	100	64	64	13F6	57	0	45	45	14A1	71	0	0	0	0
2707 ♂	8J2	100	82	18	5A7	57	0	0	0	14A2	71	0	0	9	0
2718 ♀	8J5	100	82	82	5A7	57	0	0	0	14A2	71	0	0	9	0
2800 ♂	8C4	100	18	64	3A7	28	0	0	0	14A3	71	0	0	18	0
Loxocemus bicolor sumichrasti															
2526 ♀	8L1	100	100	0	7A11	86	0	82	0	8H1	100	64	0	0	0
2530 ♀	8L1	100	100	0	7A11	86	0	82	0	8J2	100	82	18	0	0
2717 ♀	8C5	100	18	82	7C9	86	18	18	0	8H1	100	64	0	0	0
2737 ♀	8E4	100	36	64	8L10	100	100	64	0	8J1	100	82	0	0	0

The following table gives comparative material on scalation and measurements:

Number	Scale Rows	Abdominals	Caudals	Labials		Length			Ratio %
				Supra	Infra	Body	Tail	Total	
Loxocemus bicolor bicolor									
2507 ♂	31–33–25	254	42	11–11	12–12	477	56	533	10.5
2522 ♂	31–33–26	256	39	11–11	12–12	652	68	720	9.4
2707 ♂	31–35–26	260	41	11–12	12–12	620	67	687	9.8
2718 ♀	29–33–25	254	42	11–11	12–13	695	80	775	10.3
2800 ♂	33–33–25	256	40	11–11	14–13	878	86	964	8.9
Loxocemus bicolor sumichrasti									
2737 ♀	31–33–25	263	46	11–11	14–13	1061	125	1186	10.5
2530 ♀	31–33–26	252	42	9–9	11–12	555	60	615	9.8
2717 ♀	31–33–26	254	41	11–11	11–12	647	72	719	10.0
2526 ♀	31–33–25	251	41	10–10	12–13	543	62	605	10.2

Discussion.—Dr. Hobart M. Smith (1943, p. 445) has considered these two forms as distinct species, but the evidence at our disposal raises the question whether they are separate species or merely subspecies. Admittedly, the evidence is inconclusive, and any decision at the present time, based upon such evidence as is now available, must of necessity be only tentative, pending the accumulation of more conclusive data.

No evidence is available to indicate that the two forms occupy different habitats. In fact, the field notes of the collector indicate that both forms were taken from the same habitat in wooded areas containing leaf litter, fallen logs, and loose soil, presumably during the dry season. Smith (letter, March 5, 1944) adds that they appear to be underground during the dry season. Without contradictory evidence, it must be assumed that they occupy the same niche in the same habitat in Oaxaca.

According to Smith (letter, September 19, 1942), the two forms occupy the same range from the Isthmus of Tehuantepec northwestward to Morelos and Guerrero, a distance of about 300 miles; but beyond that to Colima, another 300 miles, only *sumichrasti* is known, while southeastward from the isthmus to El Salvador, about 400 or 500 miles, only *bicolor* is known.

Presumably, the habitat occupied in Oaxaca is typical of that throughout the range of both forms. Smith (1942, p. 201) has implied in a similar case that there might be some sort of a barrier separating two forms in the same habitat. He indicates (letter, March 5, 1944) that such barriers may include breeding at different times of year, repugnance to odor, emergence at different times of day or night, or many other possibilities. To date, however, no such barriers have been discovered; at least none are known to the writers. In the absence of evidence about such barriers, one way or another, the writers are inclined, on the basis of other evidence, to assume that they do not prevent interbreeding.

In relation to scalation, Smith (letter, December 23, 1943) states, "I early dropped the idea of any constant differences in scutellation; they may exist, but I did not discover them, and those proposed by Taylor do not hold." Smith's conclusion seems to fit our specimens from Oaxaca, where the chin-shield characters suggested by Taylor (1940a, p. 447) show considerable intergradation. We do not know whether there might be constant differences between specimens from Colima and El Salvador, extremes of the two ranges. If so, the condition in Oaxaca would indicate intergradation. Otherwise, the hereditary scutellation in the two forms is so nearly identical as to be indistinguishable in the present state of knowledge.

Dorsal color appears to be as indistinguishable as scalation. It is in the ventral color where differences appear. Some are darker than others underneath. The abdominal color seems to show some indications of intergradation between the dark and light phases, but chins show decided contrast, some light, others with dark markings.

This is the critical difference in heredity be-

tween the two forms, and the question arises whether such differences could be maintained in heredity if interbreeding occurs. So far as the writers are aware, there is nothing in genetics against the idea of inheritance of alternative characters in the same interbreeding population. The light and dark chins may well be alternative characters transmitted by the same parents. They may even be unit characters that cannot intergrade.

Klauber (1936, p. 18; 1939, pp. 1–23) has shown that king snakes in California may transmit to different members of the same brood either the striped or the banded pattern, which would be suspected of belonging to much more complicated heredity patterns than the chin color of the American pythons. It thus seems that it stands well within the realm of possibility, as well as of probability, that these chin patterns could well be transmitted within an interbreeding population in distinct form so that the possessors could readily be distinguished from one another, even though they might intergrade or be indistinguishable in all other characters.

If it be an interbreeding population where the two ranges overlap, how can the spread of one form to the north and the other to the south be explained? Would it necessarily imply that the two forms had once been separated and had later been freed of the separating barrier and are now gradually mixing so that the forms will eventually become completely mixed and the distinctions vanish? Or might it imply that the two types arose in the same population and one spread southward and the other spread northward? If so, might this be another example of the principle of segregation of different types in different geographic areas of which there are so many examples everywhere, the genetics of which are discussed by T. Dobzhansky in his *Genetics and the origin of species* (1937, p. 147), and by R. C. Murphy in his article on "The Need of Insular Exploration as Illustrated by Birds" (Science **88**: 535). 1938)?

In light of the well-known Jordan's rule, which holds that the nearest relative of a species is not found in the same area, but in an adjacent area separated by some sort of barrier, it could not be maintained that these forms represent different species unless a barrier of some sort could be found to prevent interbreeding and force them into different niches in the habitat.

The rule of ecological incompatibility, based upon extensive evidence from paleontology, zoogeography, and taxonomy, is even more convincing. This rule (Ángel Cabrera, 1932, p. 114; 1935, p. 509) holds that "related animal forms are ecologically incompatible, and their incompatibility is the more profound, the more directly they are related." It seems inconceivable that two forms could occupy the same ecological niche in competition with each other without either interbreeding or being crowded into separate niches.

In light of the available evidence, it seems that the weight tips the scales heavily in the direction of the idea that the snakes represent one species with two subspecies that interbreed in the intermediate range. This conclusion seems tenable unless and until evidence is found to show that the two forms occupy different niches in the same habitat separated by some kind of barrier. This conclusion seems to be in harmony with the practices in the much more intensively studied fields of ornithology and mammalogy.

Constrictor constrictor imperator (Daudin)

BANANA BOA

Three females, found around banana groves. Dorsal ground color light brown or gray. Dark lines on head form a cross between eyes. A series of 25 to 29 dark brown biconcave transverse dorsal blotches, sometimes with small light centers and sometimes connected laterally to enclose oval dorsal areas of lighter ground color. A dorsolateral series of small triangular blotches are separated anteriorly by a lighter line about 2 or 3 scales wide from the dorsal blotches with which they tend to alternate, but with which they tend to coalesce posteriorly, enclosing portions of the light line which finally disappear before the tail is reached. A series of diamond-shaped dark brown light-centered lateral blotches run the length of the body. Ventral ground color is creamy white, mottled with light brown and with a tendency toward a double row of black spots or groups of spots which run the length of the body and fuse into a single row on the tail.

Dorsal scale rows, 54-63-36, 60-75-41, 55-75-36; supralabials, 16-16, 19-20, 18-18; infrala-

bials, 19-19, 23-23, 22-23; dorsal body blotches, 27, 25, 29; abdominals, 240, 250, 257; caudals, 59, 68, 67 respectively; anal entire. Greatest length, body 646 mm, tail 83, total 729; tail 11.4 to 13.1 per cent of total length.

Masticophis mentovarius mentovarius
(Duméril and Bibron)

Six specimens, all collected in banana groves, apparently feeding on rats and mice. These specimens of different sizes and ages show sequences in changes of the color pattern. The most conspicuous juvenile pattern occurs on a specimen (UU 2771 ♀) 1,130 mm in length and probably about three years of age. The top of the head is dark brown, and this extends onto the sides but is there mottled with cream, especially on the preoculars and postoculars and upper labials. Behind the head the brown dorsal color is darker in the neck region but lighter on the posterior half of the body, where it becomes suffused with pink, especially on the sides and on the tail. The ventral ground color is cream or yellow anteriorly and is mottled on chin and throat with dark brown spots which tend to form two central rows. The cream or yellow ground color is gradually replaced by pink on the posterior abdomen and tail.

On the side of the neck a series of distinct light and dark lines extending backward tend to become fainter and disappear posteriorly, but two of the lines persist faintly as far as the anus. Each dark line consists of dark spots or streaks through the center of successive scales with one exception, in which case the line is located on the ends of abdominals. The light lines include the lateral edges of the scales and tend to run between the scale rows. Dorsally the dark spots on the scales become enlarged and occupy most of the scale surface and the light lines tend to become obsolete. One centimeter behind the head the first, second, and fifth light lines are most conspicuous. Four centimeters behind the head the fourth line is lost by reduction of scale rows. Posteriorly the lines disappear by reduction in contrast of colors.

A second specimen (UU 2784 ♂) of approximately the same size and age, 1,160 mm in length, has the same pattern except that the lines do not persist so far posteriorly.

An 866-mm specimen (UU 2715 ♀) about two years of age shows essentially the same pattern with slight variations. Just behind the head the second and fifth light lines are most conspicuous, and dorsally the ninth light lines form a conspicuous pair that extend backward a short distance and forward to make semicircular turns around the side of the neck to the angle of the mouth just missing the last upper labials. The dorsal color anteriorly behind the head is dark gray rather than brown.

A 548-mm specimen (UU 2719 ♀) about one year of age closely resembles the preceding specimen except that the first light line is nearly as conspicuous as the second and the ninth stripes although discernible are inconspicuous.

By contrast with these young specimens, two older specimens (UU 2528 ♂, 2792 ♀), 1,690 and 1,741 mm in length, except for a decided reduction in the line effects, show the typical color pattern with brown head, dark gray dorsal anterior color intergrading posteriorly with brown and ventral color essentially as previously described. Some of the lateral lines are faintly discernible, the second being most conspicuous.

Scalation: Scale rows, 19-17-13; supralabials, 7-7; infralabials, 10-10 in four specimens, 9-10 in one, and 9-9 in one. Preoculars 2-2 in five, and 3-2 in one specimen; postoculars, 2-2; loreals, 1-1 in four specimens, 1-2 in one, and 2-2 in one. Nasal divided.

Slight sexual dimorphism is indicated in the following comparison of the sexes: 2 males show 187 and 192 (189.5) abdominals, 109 and 114 (111.5) subcaudals, 836 and 1,225 mm body length, 324 and 465 mm tail length, and ratios of 27.5 and 27.9 per cent tail to total length; whereas 4 females show comparative figures of 194 to 201 (198) abdominals, 107 to 112 (109) subcaudals, 410 to 1,292 mm body length, 138 to 449 tail length and ratios of 25.2 to 27.3 per cent tail to total length.

Discussion.—Basically the striping pattern of longitudinal dark spots or streaks through the centers of scales and light streaks between scale rows formed by light lateral edges is identical with the striping pattern of *M. t. taeniatus.* Even the emphasis on the stripes is very similar. The light stripes are more conspicuous on the sides, but the dark stripes so dominate the dorsum that the light stripes are nearly obsolete in both races.

There are, of course, some differences. In *taeniatus* this pattern is distinctly visible

throughout the full length of the body and extends even on to the tail, whereas in the young of *mentovarius,* up to about three years of age, it is distinctly visible only on the anterior part of the body and fades posteriorly until it is nearly obsolete near the anus. In adult specimens, however, this fading is much more pronounced but is generally recognizable on the neck, even though it may become completely obsolete elsewhere.

This similarity of the adult *taeniatus* to the young *mentovarius,* even though the posterior part of the pattern is only faintly visible, is so striking as to strengthen the hint given by Hartweg and Oliver (1940, p. 19) that *mentovarius* might belong to the *taeniatus* group. This raises the question of whether the faintly visible pattern of the young *mentovarius* is an expanding pattern which will eventually spread to the adult stage or a remnant of a more complete pattern like that of *taeniatus* which has been nearly lost in the adult and is now being suppressed in the young.

The preponderance of available evidence favors the latter idea that color patterns of young reptiles are atavistic. It is consonant with the general idea of growth and development in which the zygote is generalized and successive steps of cell multiplication offer chances for more and more specialization. The older the individual and, consequently, the farther removed from the zygote the greater is the chance for divergence from ancestral conditions. This idea is essentially in agreement with Eimer,[2] who outlined color pattern changes in the lizards of the genus *Lacerta* of the Old World and with Cope,[3] who did likewise with the lizards of the genus *Cnemidophorus* in the New World both of which practically parallel the present case. In both genera striping was considered to be primitive, and it was shown that adults of some species maintained the striped pattern throughout life, whereas others abandoned the striped color pattern of the young in later stages of life, and developed other color patterns of broken lines, crossbands, reticulations and finally spots on a plain background, some species reaching one stage, other species continuing on through to the other stages.

In the absence of evidence to indicate a mutation producing a striped pattern of the embryo from nonstriped parents in the *Masticophis* snakes, the alternative idea of atavistic color patterns in the young becomes predominant.

In the matter of scalation, Stuart (1941, p. 31) indicates a reduction trend in dorsal scale rows in the *Dryadophis–Salvadora–Masticophis–Coluber* series. If this conclusion be accepted, then the higher scale formula, 19-17-13 in *mentovarius* is doubtless more "primitive" than the 15-13 formula of *taeniatus.* This suggests the idea that the latter has been obtained by reduction from a larger scale-formula, probably similar to that of the former.

If the implications of Stuart (*ibid.*) in relation to the probable derivatives of *Dryadophis* are tenable, then it seems possible that the genus *Masticophis* could have been derived from South American stock that spread northward through Central America. In that case, the evidence would tend to support Smith's hypothesis (1941, pp. 388, 396) that the northern races had been derived from primitive stock south of the Isthmus of Tehuantepec.

The evidence from scalation is in agreement with this hypothesis, but the evidence from color pattern seems to call for a slight modification of Smith's (*ibid.*) conclusion that *mentovarius* "represents the nearest approach to the ancestral type of pattern in the genus." This can be brought into harmony by assuming that the primitive ancestor had both high scale-formula and full body pattern. Then both *taeniatus* and *mentovarius* could be derived, the former by reduction in scale formula, the latter by reduction of color pattern from the primitive conditions.

Thamnophis ruthveni Hartweg and Oliver

Eight specimens were collected in light brush open fields, and pastures, around water. These snakes fit closely the description of Oliver (1938, pp. 1–4) from this same locality. The lower two postoculars are white as is the posterior half of the preoculars. Two males have: Abdominals 151, subcaudals 71 and 74, body length 346 and 350 mm, tail length 96 and 102 mm, ratio of tail to total length 21.7 and 22.6 per cent. Six females have: Abdominals 143 to 152 (146), subcaudals 59 to 70 (63.7), body length 334 to 570 mm, tail length 94 to 130+ mm, ratio of tail to total length 20.4 to 22.0 per cent.

[2] Archiv für Naturg. **1881**: 239.

[3] *The primary factors of organic evolution:* 41–45. 1896.

Salvadora lemniscata (Cope)

Nine specimens were collected in banana and coconut groves and open fields. These specimens all agree with Bogert's description of this species (1939, pp. 140–147). Eight males have: Abdominals 200 to 206 (203), subcaudals 135 to 140 (138), body length 721 to 1,150 mm, tail length 344 to 485 mm, ratio of tail to total length 30.9 to 32.3. One female has: Abdominals 205, subcaudals 141, body length 752 mm, tail length 348 mm, ratio of tail to total length 31.6 per cent.

Drymobius margaritiferus fistulosus Smith

Two specimens, an adult female and an immature male. In general, the adult fits Smith's description (1942, p. 383) of the types. The black scales with light centers show considerable variation, but all or nearly all show a complete black border. On the dorsum the light center is light blue, with a longitudinal yellow streak through its center. On the sides the blue center gradually increases its area on each scale at the expense of the black until the first scale row and the ends of the ventrals show the light blue areas in conspicuous contrast with the narrow black borders which are wider on the posterior edges. In the same direction the yellow streak diminishes in intensity until it is nearly obsolete on the first scale row and entirely missing on the ends of the ventrals. The black borders of the ventrals (abdominals and subcaudals) are limited to the extreme ends.

The young male is similar, except that the yellow streak is missing in the blue portions of the scales and the ventrals have longer and more conspicuous black borders.

Scalation: Scale rows 17-17-15. Supralabials 8-8 with 4 and 5 in orbit and 3 barely entering, and 9-9 with 5 and 6 in orbit and 4 barely entering. Infralabials 10-10 and 10-9. Preoculars 1-1; postoculars 2-2. Abdominals 148 and 151; subcaudals 29 + and 117.

Length: Body 645 and 199; tail 105 + and 104 mm; total 750 + and 303. In young male, tail represents 34.3 per cent of total length.

Dryadophis melanolomus tehuanae Smith

Six specimens collected in hilly country in second-growth timber. In alcohol, general appearance above, nearly unicolor (lighter on tail) slate tinged with blue or brown and slate blue in freshly shed specimens. Closer examination, however, reveals that many scales have dark edges anteriorly and slate blue centers, whereas other scales, especially on the anterior part of the body, have the dark pigment extending over most of the scale. All scales have white fringes on the posterior V-shaped edges which produce the appearance of diamond shaped white markings around each scale, which is a conspicuous feature of the general pattern.

Scalation: Dorsal scale rows 17-17-15. Supralabials 9-9 except one which is 8-9. Infralabials 10-10 in 3 specimens, 9-10 in two and 9-9 in one. Preoculars 1-1 in 4 specimens and 2-2 in two. Postoculars 2-2. Abdominals 177, 178, 181, 181, 183, 184. Caudals in the same sequence 55 +, 107, 113, 97 +, 103, 111. Body lengths 591 ♂, 675 ♂, 709 ♂, 740 ♀, 765 ♂, 780 ♀ mm; tail lengths 222 +, 165 +, 283, 306, 326, 314 mm; total length in same sequence 813 +, 840 +, 992, 1046, 1091, 1094 mm. Ratio of tail to total length, males 28.5 to 29.9 per cent; females 28.7 to 29.3 per cent.

Drymarchon corais melanurus (Duméril and Bibron)

Three specimens, two females and a male, which seem to be intergrades between *melanurus* and *rubidus* as described by Smith (1941, p. 476). Two of the snakes, Nos. 2583 ♂ and 2746 ♀, are nearer *melanurus* than *rubidus*. They are both distinctly lighter anteriorly than posteriorly. The preocular labials are partly edged with black, and the light areas of the labials are light brown, not white. Most of the posterolateral gular scales are tipped with black. Anteriorly, about one-third of the ventral plates are black on the posterolateral surface of one or both sides. Although not of regular pattern, these black streaks become progressively longer and more frequent until they cover the scales forming a solid black color posteriorly on body and tail for about one-third of its length. No. 2521 ♀ is nearer *rubidus*, being much darker dorsally than the others, but there is much less contrast between the anterior and posterior portions of the body. The dorsal surface of the head is nearly black. All the supralabials are edged posteriorly with black, and the light areas are light brown. Nearly all of the gular scales are tipped with black. The ventral pattern, although similar to the others, has much more black pigment.

Scalation: Supralabials 8-8; infralabials 9-9. Dorsal scale row formula 19-17-15 or 14. Abdominals: one male 188, 2 females, 195 and 191. Subcaudals: male 78, females 72 and 71. Measurements. Body length: male 1,320 mm, females 1,215 and 840 mm. Tail length: male 321, females 281 and 201 mm. Ratio of tail to total length: male 19.6 per cent, females 18.8 and 19.3 per cent.

Elaphe chlorosoma (Günther)

A young female showing distinctly the juvenile pattern has a series of 59 dorsal blotches with light brown centers and dark brown edges on the body and 25 less distinct blotches on the tail. These body blotches, reaching to the fourteenth scale rows, run transversely diagonal across the dorsal surface through the light brown ground color. Anteriorly on the body there is a series of lateral blotches which alternate with the dorsal blotches for about one-fourth the length of the body. Posteriorly they become indistinct. The ventral surface is immaculate.

Scalation: Scale rows 31-37-23. Abdominals 274; subcaudals 111. Anal divided. Supralabials 8-8; infralabials 9-10. Preoculars 1-1; postoculars 2-2. Length of body 585 mm; of tail 149 mm; total 734 mm. Tail represents 20.3 per cent of total length.

Leptophis diplotropis diplotropis (Günther)

Fourteen specimens, arboreal in habit, from banana groves and light forested areas. The basic color is blue, darker above than below. In alcohol, it varies dorsally from a light blue (34 F 6 near lotus) through varying stages of pigmentation to a very dark blue (40 A 6 near slate). Two phases of coloration seem to be exhibited, a dark and a light phase.

The light phase has a black line running through the orbit, extending forward faintly to nostril and involving the upper edge of labials. Posteriorly, it occupies the lower postocular, most of the first temporal, the lower post temporal, upper edges of last two labials and the lower edge of the upper posttemporal. The head above is light blue and below is mainly white, usually being suffused with blue on the upper labials and the lateral gulars.

Behind the head the black line widens until it involves scale rows 3 to 6 and edge of row 7. Back about 5 or 6 centimeters this line begins to break into obliquely transverse dark blotches, which gradually become less distinct and disappear about a third or half way along the body. Along the center of the back, the vertebral scales are much lighter in color, some nearly white, giving the appearance of a chain of light-colored diamonds. Behind the neck the paravertebral scales become keeled and the keels become colored black, thus forming a pair of narrow black paravertebral lines which extend backward to the anus. The white of the throat gradually becomes suffused with blue posteriorly.

The dark phase is similar but darker and has black covering the entire top of the head and neck, except the light vertebral diamonds.

Scalation: Scale rows 15-15-11. Supralabials 8-8, except one 8-9; infralabials, 10 with 11-11, 3 with 11-10, and 1 with 10-10. Preoculars 1-1; postoculars 2-2. Loreal single. Nasal divided.

LEPTOPHIS DIPLOTROPIS DIPLOTROPIS (GÜNTHER)

No.	Sex	Abdominals	Caudals	Length			Ratio (%)
				Body	Tail	Total	
2567	♂	169	117+	601	—	—	—
2569	♂	173	152	610	334	944	35.4
2579	♂	171	137	642	346	988	35.0
2713	♂	171	127	636	339	975	34.8
2714	♂	174	138	691	345	1036	33.3
2728	♂	172+1	137	682	355	1037	34.2
2729	♂	173	148	768	441	1209	36.5
2730	♂	174	111+	682	306+	988+	—
2753	♂	173	134+	710	379+	1089+	—
2791	♂	176	134	763	393	1156	34.0
2754	♀	177	99+	750	302+	1052+	—
2765	♀	175	116+	632	291+	923+	—
2766	♀	172	125	630	312	942	33.1
2772	♀	174	134	595	311	906	34.3

Trimorphodon biscutatus biscutatus (Duméril and Bibron)

Fourteen specimens, nocturnal in habits, from hillsides and lowlands, light forests, or open areas.

Coloration: Gray above, yellowish below with dark brownish-gray blotches forming series along the back, along the sides and along the ends of the ventrals. The dorsal series shows a great deal of variation, ranging from plain transverse light-centered blotches (secondary), toward one extreme becoming narrower and less distinct until only a light brown area is left (tertiary blotches), and toward the other extreme becoming wider and more conspicuous

until some partially split to make pairs of light centered blotches (primary) joined at the lateral ends; but occasionally separated.

According to our interpretation these variations of blotches represent developments of some at the expense of others. In order to explain the present pattern, we propose to assume a hypothetical primitive ancestral pattern derived from evidences still persisting on the specimens. This pattern consisted of light areas alternating with dark dorsal blotches which numbered about 65 to 72 on the body and a similar pattern extended on to the tail.

A change in this pattern was produced by expansion of alternate dark blotches, correlated with a suppression of the others both in size and color, leaving a pattern of about 32 to 36 dark blotches alternating with light tertiary blotches bordered by the primitive light interblotch areas, presumably like *quadruplex*.

Some specimens show an additional or secondary reduction, especially in the midbody region, in which some alternate dark blotches (usually not all) expand in correlation with suppression of those secondary dark blotches between them, leaving a pattern usually unchanged on neck and posterior body, but showing in midbody some expanded primary blotches alternating with narrower more or less suppressed secondary blotches which in turn are bordered by the plain remnants of the tertiary blotches which again are usually bordered by the light interblotch sections. In a few cases, these latter light areas are missing and the plain tertiary remnants are fused with the secondary blotches to make one on the dorsum but laterally the three are often clearly indicated.

The number of primary blotches left depends largely upon the number and amount of secondary reductions. It is nearly impossible to set a precise limit between primary, secondary and tertiary blotches because they show all degrees of gradation between them. Separated on the basis of judgment, the specimens show a range of 20 to 33 primary blotches.

Scalation: In all specimens, both nasal and anal are divided; both pre- and postoculars are 3-3, except one specimen which has 4 postoculars on one side. Some variable characters are listed in the table below.

A comparison of ventrals on our specimens with similar data taken from Smith (1941, p. 158; 1943, p. 492) for populations from nearby regions is given as follows: UU specimens: Abdominals 245 to 267 (259), subcaudals 83 to 96 (88), total ventrals 335 to 357 (346). *T. b. semirutus:* abdominals 260 to 275, subcaudals 85 to 102, total ventrals 358 to 376. *T. b. biscutatus:* abdominals 251 to 271, subcaudals 81 to 96, total ventrals 343 to 359. *T. b. quadruplex:* abdominals 251 to 263, subcaudals 82 to 93, total ventrals 334 to 347.

Imantodes splendidus oliveri Smith

Two females from open forested areas and hillsides. Color patterns fit description given by Smith (1942, p. 388).

Scalation: Dorsal scale rows 17-17-15. Anal divided. Supralabials 8-8. Infralabials 10-10.

TRIMORPHODON

No.	Sex	Scale rows	Abdominals	Caudals	Total ventrals	Labials		Loreals	Body blotches	Length			Ratio (%)
						Supra	Infra			Body	Tail	Total	
2523	♂	25–25–20	255	96	351	9–9	13–13	3–3	21	771	184	955	19.3
2722	♂	26–27–20	254	93	347	10–9	12–13	4–3	27	860	202	1062	19.0
2744	♂	25–25–20	245	90	335	9–9	12–12	3–3	20	452	96	548	17.5
2554	♀	25–26–19	262	85	347	9–9	13–12	2–2	22	941	184	1125	16.4
2710	♀	25–26–19	264	86	350	9–9	13–13	3–3	23	490	99	589	16.8
2711	♀	25–27–19	266	83	349	9–9	12–12	2–3	22	951	183	1134	16.1
2721	♀	25–25–20	247	91	338	9–9	12–12	2–3	22	767	189	956	19.8
2745	♀	25–27–20	261	83	344	9–9	12–13	2–3	22	467	88	555	15.9
2760	♀	27–28–20	267	64+21	352?	9–9	12–13	3–3	24	1074	177+	1251+	—
2762	♀	26–26–19	253	84	337	9–8	12–13	3–3	24	724	171	895	19.1
2770	♀	25–26–21	267	90	357	9–9	13–14	3–3	24	994	135+	1129+	—
2776	♀	23–26–19	262	86	348	9–9	12–12	3–3	23	559	105	664	15.8
2777	♀	25–27–20	264	88	352	9–9	14–14	3–3	22	881	189	1070	17.7
2783	♀	25–28–22	256+1	69+17	342?	9–9	13–13	3–3	33	930	160+	1090+	—

? indicates estimated value.

Preoculars 1-1, postoculars 2-2. Loreal single. Nasal single. Abdominals 237 and 225; caudals 132 and 123, respectively.

Length: Body 628, tail 252, total 880 mm; body 605, tail 239, total 844 mm. Tail 28.6 and 28.3 per cent respectively of total length. Vertebral scales only slightly larger than adjacent paravertebral scales.

Leptodeira maculata (Hallowell)

Three specimens found usually in brush. Dorsal ground color light brown. There are 26–29 dark brown blotches extending from the neck to the anus and 12 on the tail. Some of these blotches are confluent. The blotches extend laterally to the first, second, or third scale rows. Ventrals immaculate.

Scalation: Nasals divided. Loreal single. Both preoculars and postoculars 2-2. Supralabials 8-8; infralabials 10-10. Anal divided. Scale rows 21-21-17, 21-23-17, 21-25-17. Abdominals 167, 171, 175. Subcaudals 74, 33+31 estimated (broken), 67.

Body lengths 380, 408, 494 mm, tail lengths 115, 56+, 121 mm. Ratio tail to total length: male 23.2 per cent, female 19.7 per cent. Body blotches: male 26, female 29. Tail blotches 12.

Manolepis putnami (Jan)

Three specimens collected toward evening on open roads around open brush under which they spend the night, according to the collector. The color fits the description given by Cope (1898, p. 1092).

Scalation: Dorsal scale rows 19-19-15. Anal divided. Upper labials 8-8. Lower labials 10-10. Preoculars 1-1. Postoculars 2-2. Loreal absent. Nasal divided. Abdominals: one male 169, 2 females 179 and 180. Subcaudals: male 73, females 64 and 65.

Body length: male 399 mm, females 315 and 500 mm. Tail length: male 121, females 77 and 130 mm. Ratio of tail to total length: male 23.3 per cent, females 19.6 and 20.6 per cent.

Conophis vittatus viduus Cope

Sixteen specimens taken from sparsely wooded or lightly forested areas, particularly around the edges of openings in the forests. Ground color creamy white with one dorsal and two lateral black or brown stripes, two or three scale rows wide, beginning at the rostral edge and running posteriorly to the tail where they become faint on the tip. The lateral stripes border the upper edge of labials and pass through the orbit under the supraoculars.

Scalation: Dorsal scale rows 19-19-17 in all but two specimens which show 19-19-15. Anal divided. Upper labials 7-7. Lower labials 8-8 in 4 specimens, 9-8 in one, 9-9 in eight, 9-10 in two and 10-10 in one. Preoculars 1-1 in twelve specimens, 1-2 in three and 2-2 in one. Postoculars 2-2. Loreal single. Nasal divided. Abdominals: 9 males 154 to 166 (159.6), 7 females 162 to 170 (167). Subcaudals: males 61 to 69 (65), females 57 to 67 (62.8).

Total length: males 454 to 724 mm, females 222 to 752 mm. Tail length: males 111 to 156 mm, females 45 to 142 mm. Ratio of tail to total length: males 20.8 to 24.9 per cent, females 17.4 to 20.8 per cent.

Oxybelis acuminatus (Wied)

Nine specimens taken in arboreal habitats in low second-growth timber. Ground color generally ashen to brownish gray and brownish red, both below and above. Head above same as body. Supralabials creamy white separated from dorsal head color by a black line which extends from edge of rostral along upper border of labials to neck region. Lower labials, chin and neck are creamy white, the color gradually fading into ground color on first few abdominals.

Scalation: Dorsal scale rows 17-17-13 in all but two specimens which show 17-17-15. Anal divided. Upper labials 9-9 in 6 specimens, and 9-10 in three. Lower labials 9-9 in 2 specimens, 10-10 in two, 10-11 in three, 10-12 in one, and 11-11 in one. Preoculars 1-1. Postoculars 1-1 in two specimens, and 2-2 in seven. Loreal absent. Nasal single. Abdominals: 5 males 186 to 194 (191), 4 females 188 to 199 (193.5). Subcaudals: 5 males 167 to 181 (175), 3 females 163 to 168 (165).

Total length: 5 males 1,276 to 1,468 mm, 3 females 1,313 to 1,395 mm. Tail length: 5 males 531 to 609 mm, 3 females 510 to 539 mm. Ratio of tail to total length: 5 males 40.4 to 42.1 per cent, 3 females 38.6 to 38.8 per cent.

Tantilla rubra Cope

Two specimens, female and juvenile, found under refuse and fallen timber, feeding prin-

cipally on small insect life, according to the collector. Color as described by Smith (1942, p. 40), except that in addition part of the lower labials are black.

Scalation: Scale rows 15-15-15. Abdominals 147 and 164; subcaudals 60 and 68. Labials all 7-7 except one with infralabials 6-6. Preoculars 1-1; postoculars 2-2. Loreal missing; nasal divided; anal divided.

Length: 260+85 mm and 116+31 mm; totals 345 and 147 mm; ratio of tail to total, 24.6 and 21.1 per cent.

Coniophanes imperialis copei Hartweg and Oliver

Three specimens collected under refuse and fallen timber. Color as described by Hartweg and Oliver (1938, p. 4). In addition, the male is darker than the females and all three specimens show two short lines produced by rows of dark specks on the ends of the anterior ventrals.

Scalation: Dorsal scale rows 19-19-17. Upper labials 8-8. Lower labials 9-9. Preoculars 1-1. Postoculars 2-2. Loreal single. Nasal divided. The male has 128 abdominals, 78 subcaudals, body length 234 mm, tail length 110 mm, total 344 mm, tail 31.9 per cent of total length. Two females have 131 and 135 abdominals, tails broken, body lengths 172 and 220 mm.

Coniophanes piceivittis Cope

A single specimen, a female, was collected. Dorsal ground color dark brown, with two dorsolateral white stripes running from the rostral above the orbit along the edge of the supraocular, along the outer edge of the parietals and on to the neck 6 or 7 scales, where they are broken for 2 scales and thence extend posteriorly to the tip of the tail. The white stripes occupy scale row 8 and halves of 7 and 9. The ventrals and the first three scale rows are immaculate, except on chin, lower and upper labials where the white is conspicuously stippled with dark brown. The yellow parietals and frontal are also stippled with brown.

Scalation: Dorsal scale rows 23-25-19. Anal divided. Supralabials 8-8; infralabials 10-10. Preoculars 2–2; postoculars 2-2; loreal single; nasal divided. Abdominals 172. Part of the tail is missing. Body length 155 mm.

Micrurus ephippifer (Cope)

A single female was collected under rubbish. Tip of head back to posterior tip of frontal, tip of parietals on top and postoculars and half of third supralabial on sides is black; mental and first two infralabials are also black. Behind this black ring is a yellow ring (white in alcohol) which extends back nearly to the posterior edge of the parietals and laterally through the last infra and supralabials. Behind this is a black nuchal color which involves the posterior tip of the parietals and extends posteriorly eight scales in the dorsal surface and ends on the fourth abdominal ventrally. There are fifteen black rings (5 abdominals wide) on the body and three on the tail. These 15 complete black rings are bordered on both sides by yellow (white) rings about $2\frac{1}{2}$ scales wide which enclose 14 red rings that have the dorsal surfaces mostly replaced by black but some red edges persist. This dorsal black extends down the sides usually to the third, second or first scale rows producing some concave borders anteriorly and a few black spots occur on the ventral surface.

Scalation. Scale rows 15-15-15. Labials 7 and 7. Preoculars 1-1; postoculars 2-2. Loreal absent. Nasal divided. Abdominals 224; subcaudals 36. Body length 400 mm, tail 41 mm, total 441 mm. Tail 9.3 per cent of total length.

Stenorhina freminvillii lactea Cope

Two females collected in underbrush. Color in alcohol light red above on head, body, and tail. This color becomes gradually lighter on sides and fades into pink on the ventral surface, being darker under the tail and progressively lighter anteriorly toward the chin. The upper and lower labials are a very light pink. One specimen has a narrow black streak beginning on the upper edge of second supralabial which extends backward along the upper edge of the labials, through the eye, involving the preocular, lower postocular and ending on the seventh labial. On the other specimen, this line is nearly missing. Both specimens show suffusion of dark pigment on the parietals and indications of a faint middorsal line extending backwards.

Scalation: Dorsal scale rows 17-17-17. Anal divided. Labials all 7-7 except one has 7-8 infralabials. Preoculars 1-1; postoculars 2-2. Loreal 1-1 in one specimen, and 1-0 in the other. Nasal divided; temporals 1-2-3. Abdominals 167, 179;

caudals 39, 35. Body length 472, 510 mm; tail length 83, 73 mm; total length 555, 583 mm. Tail 15 and 12.5 per cent of total length.

Bothrops dunni (Hartweg and Oliver)

Eleven specimens, four adults, and seven juveniles from wooded and brushy areas around open fields, in nearly the same type habitat as the rattlesnake. Color as described by Hartweg and Oliver (1938, p. 6). The dorsal blotches vary from 13 to 20 in number. Adult males are darker than the females and some of the juveniles can be similarly separated, but others are indistinguishable.

Scalation: Dorsal scale rows 23-23-19 in six specimens and 25-23-19 in three specimens. Anal entire. Supralabials 9-10 in two specimens, 10-10 in five, 10-11 in one, and 11-11 in one. Infralabials 9-11 in one specimen, 10-10 in four, 10-11 in three, and 11-11 in one. Preoculars 3-3. Postoculars 3-3 in seven; 3-4 in one, and 2-2 in one specimen. Nasal divided. Abdominals: 7 males 145 to 151 (147), 4 females 150 to 156 (152.5). Subcaudals: males 37 to 41 (40), females 32 to 38 (35). Body length: Males 159 to 348 mm, females 192 to 415 mm. Tail length: males 23 to 56 mm, females 22 to 53 mm. Ratio of tail to total length: males 12.1 to 13.9 per cent, females 10.3 to 11.6 per cent.

Crotalus atrox Baird and Girard

A single female was collected. Dorsal scale rows 25-25-21. Anal entire. Supralabials 16-15; infralabials 16-16. Preoculars 3-3; postoculars 2-3. Loreal single. Abdominals 179; subcaudals 24. Length: body 294 mm, tail 20 mm, total 314 mm. Tail 6.4 per cent of total length. Body blotches 39; tail blotches 6. The snake contained a *Cnemidophorus* lizard.

Crotalus durissus durissus Linnaeus

A single female was collected. Dorsal scale rows 29-31-21. Anal entire. Supralabials 16-15; infralabials 15–17. Preoculars 1-1; postoculars 2–3. Loreals 2–2. Abdominals 184. Subcaudals 26. Dorsal body blotches 27. Length: body 408 mm, tail 32 mm, total 440 mm. Tail 7.3 per cent of total length.

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ZOOLOGY.—*A new brittle-star* (Ophiocoma anaglyptica) *from Canton Island.*[1]

Charles A. Ely, University of Wisconsin. (Communicated by Austin H. Clark.)

H. L. Clark lists 19 species for the genus *Ophiocoma* Agassiz in his "The Echinoderm Fauna of Torres Strait."[2] All these have been known for 25 years or, in many cases, much longer. Since the publication of Dr. Clark's paper, apparently only three new species have been assigned to the genus, and one has been removed to the new genus *Ophiocomella* established by A. H. Clark in 1938. In view of the fact that the genus is a conspicuous one and already well known, the addition of another species is rather remarkable, although perhaps not surprising since the fauna of many isolated Pacific islands is still incompletely known.

Ophiocoma anaglyptica, n. sp.

Named *anaglyptica* (embossed) in reference to raised interbrachial plates.

Description.—The disk is about 20 mm in diameter, with well-spaced granules that encroach upon the interbrachial areas to a variable extent. Among the normal scales thus exposed in each interbrachial area are a number of enlarged bare plates, usually between 25 and 30. The genital slits are bordered by eight to ten small granules. In length the arms are about five times the width of the disk. The upper arm plates, which are thickened and raised above the general surface, are about two and one-half times as broad as long; of irregular outline and extremely variable in shape. The majority of these plates suggest an open low-arched fan from which one of the lateral angles has been sheared abruptly. The uppermost arm spine on the side of the missing angle is greatly swollen and enlarged, while a similar spine on the opposite side of the same segment is lacking. As a rule there is an alternation of this arrangement from segment to segment. Thus an upper plate with the right angle missing and a

[1] Received July 15, 1944.

[2] Carnegie Inst. Washington Publ. 214 (Dept. Mar. Biol., vol. 10). 1921.

swollen dorsal spine will be followed by one with a deficient left angle and a swollen left dorsal spine. Occasionally both upper plate angles are present, in which case the large spine is lacking on both sides. Conversely, both angles may be lacking and both upper spines present and enlarged. The first few segments frequently bear five spines; the next few four; and the remainder bear three on one side and four on the other alternately down the arm.

The lowermost spine is the shortest and tends to taper to a flattened blunt tip. The second lowest is slightly longer and spatulate. The next spine above is about a third longer than the one below and tapers to a rounded tip. The highest spine, when present, is typically bottle-shaped, expanded in the middle but slightly compressed; as a rule, narrowing abruptly to form a short neck. It is about two and one-half to three segments long.

There are two tentacle scales on all but the first two or three segments, each of which may bear three.

The shape of the oral shields is typical of the genus. They are roughly obovate with the proximal border nearly straight. The triangular adoral shields are equilateral and separated by the width of the oral shields. There are generally eight distinct oral papillae, with two or three small granular ones at the apex which are indistinguishable from dental papillae. The first is rectangular and lies above the second which is round and scalelike; the remainder are toothlike. There are five or six dental papillae.

The lateral arm plates are barely visible above and below.

The under arm plates are as broad as long, regular in size and shape, and overlap distally. They are pentagonal, with gently rounded angles and with slightly concave sides.

The color of dry specimens is uniformly chocolate-brown above except for white bands extending the length of the lower three arm spines and, in some instances, spotted areas at the base of the uppermost spines. The lateral intersegmental spaces are occasionally white with conspicuous black stripes extending between the lateral arm plates.

The oral surface is variously spotted and mottled with white, yellow, and light brown. The teeth and oral papillae are almost entirely white. The oral shields and proximal ventral arm plates are mottled with white and brown, but farther out on the arms the ventral plates are colored with barely visible dense dark spots on a slightly lighter background. The two lowermost spines are nearly all white near the disk; farther out they are white at the tip and become dark brown near the base. In some cases they are spotted similarly to the lower arm plates.

As seen from within the radial shields are small for the genus.

Locality.—Canton Island, reef; near shore beneath loose coral blocks. Three specimens were collected November 18, 1941.

Remarks.—The presence of 25 to 30 enlarged interbrachial plates serves to separate this new species from *O. scolopendrina* and *O. erinaceus*,

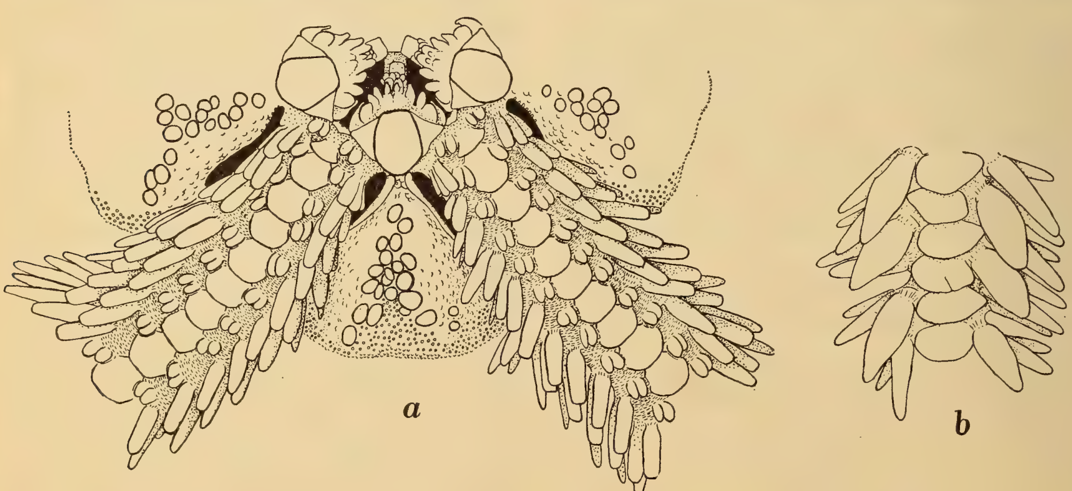

FIG. 1.—*Ophiocoma anaglyptica*, n. sp.: *a*, Oral view of disk and arm bases; *b*, aboral view of arm.

with which it seems most closely allied. Both of these species may show the general arrangement of arm spines and dorsal arm plates, but with less extreme and less regular development. In these species the fan-shaped or triangular dorsal arm plates are sheared to a lesser degree at the lateral angles, and consequently the uppermost arm spines of each segment are less conspicuously developed. However, three and four spines on opposite sides of the same segment occur in some specimens of these species. Often both species possess the flattened spatulate lower spine. In general, as shown by comparison of specimens from Canton Island, *anaglyptica* approaches *scolopendrina* more closely than *erinaceus* in these respects. However, considerable individual variation very likely occurs.

In coloration, *anaglyptica* is somewhat intermediate. The uniform coloration suggests *erinaceus*, but it is not black. On the other hand, the lighter spotted and mottled oral surface and striped lateral intersegmental areas are more typical of *scolopendrina.* Further noteworthy differences may be seen in the disk granules which are more widely and evenly spaced in *anaglyptica* than in either *erinaceus* or *scolopendrina.* Also the shape of the second innermost oral papilla is distinctive for *anaglyptica.* In this species it is round and scalelike, whereas in *erinaceus* and *scolopendrina* it is rectangular.

ICHTHYOLOGY.—*A description of a new gobiid fish from Venezuela, with notes on the genus* Garmannia.[1] ISAAC GINSBURG, U. S. Fish and Wildlife Service. (Communicated by LEONARD P. Schultz.)

The specimens forming the basis of this paper were collected by Dr. Leonard P. Schultz, curator of fishes in the U. S. National Museum, on his recent expedition to Venezuela and turned over to me for study. These comprise one specimen of *Evorthodus lyricus*, 45 specimens of *Bathygobius soporator*, and 158 specimens, in six samples, belonging to populations of *Garmannia,* most nearly related to *G. spes*. The latter specimens illustrate a common course of speciation in fishes.

Garmannia spes was described by me (JOURN. WASHINGTON ACAD. SCI. **29**: 62. 1939) from three small specimens, not in very good condition, which were brought back from the Canal Zone by Dr. Samuel F. Hildebrand in 1937. The samples collected by Dr. Schultz in Venezuela are evidently closely related to *spes*. Although these samples were taken in comparatively close proximity, within a range of about 50 miles, yet they show average morphological differences, but of varying degrees. The populations represented by the samples examined are divisible into two primary groups, which may be treated as representing two species. The other differences, within the primary groups, are of lesser degree, racial, or subspecific at the most. One of the species from Venezuela is evidently the same as the Panamanian *spes*. The other species is here described as follows and named for Dr. Leonard P. Schultz:

Garmannia schultzi, n. sp.

Diagnosis.—Anterior part of body naked, scaled posteriorly. Transverse row of scales on caudal base absent. A lengthwise row of 3–6 nonimbricate, spaced scales behind pectoral base. Head depressed to subterete. First dorsal spine not prolonged. Dorsal rays usually 11, often 12. Anal rays usually 10, often 9, infrequently 8. Pectoral rays modally 17, often 18, sometimes 16, infrequently 19. Usually diffusely and irregularly cross-banded, alternating lighter and darker, irregular areas; often nearly uniformly colored, especially in the larger males; caudal uniformly pigmented or faintly cross-banded, band at base usually rather more prominent; ventral aspect usually more or less pigmented, moderately or not much ligher than side. Extent of squamation differing markedly with sex, less extensive in male, as follows (also differs with population, see below). Male: scales extending forward to a point under base of fifth to tenth dorsal ray; transverse rows of scales 7–12, longitudinal rows 3–5. End of maxillary reaching approximately to under posterior margin of eye. Female: scales extending forward to under base of third to eighth ray; transverse rows 9–14; longitudinal rows 3–7. Maxillary ending under posterior margin of pupil.

[1] Received July 25, 1944.

Holotype.—U.S.N.M. no. 121546, male, 22 mm, Lago de Maracaibo, 7 km south of Maracaibo City; gravel and sand; March 6, 1942; Leonard P. Schultz.

Paratypes.—U.S.N.M. no. 121547; 19 males, 12–21 mm, 14 females, 12–17 mm; obtained with the holotype.

Other specimens examined.—Lago Maracaibo at Yacht Club, just north of Maracaibo City, hard bottom, rubble to gravel; 4 males, 17–28 mm, 2 females, 21–23 mm, 1 specimen, 13 mm, sex not determinable by external examination; these 7 specimens in two samples, collected March 5 and May 16, U.S.N.M. nos. 121549 and 121550, respectively. Salina Rica, coast of El Tablazo (the latter a bay between Lake Maracaibo and Gulf of Venezuela, partly continuous with both), 5 km north of Maracaibo City; bottom thick vegetation in mud; 5 males, 21–28 mm, 2 females, 24 mm, all in one sample collected February 20, U.S.N.M. no. 121548. Ciénaga del Guanavana, on coast of Gulf of Venezuela, 12 km north of Sinamaica; swampy bottom; March 11, one male, 29 mm, with 16 pectoral rays, 2 specimens, partly dried, with 17 rays, U.S.N.M. no. 121552. All specimens collected by Dr. L. P. Schultz in 1942, in brackish water. (Dr. Schultz kindly furnished the ecological notes. A discussion of the itinerary during which the samples were taken is given by Dr. Schultz in a paper entitled "The Catfishes of Venezuela, with Descriptions of Thirty-eight New Forms," Proc. U. S. Nat. Mus. **94**: 173–338. 1944.)

Squamation.—The extent of squamation, both vertically and horizontally, varies widely with the individual, and the norm differs with the population. There are several ways in which the variability of this character may be expressed: (1) by counting the number of transverse rows; (2) stating the position of the anteriormost scales with reference to the second dorsal base; (3) counting the number of longitudinal rows; (4) noting whether the dorsal aspect of the caudal peduncle is scaled over or naked. The first two ways express the horizontal extent of squamation; the last two the vertical extent. All the four ways have been determined on the specimens examined.

In counting the transverse rows, the first row usually consists of one or two scales; this row was included in the count. The number of transverse rows constitutes a fair numerical expression of the horizontal extent of squamation. It is more difficult to express adequately the variability in the vertical extent, as the number of longitudinal rows is much fewer and, what is more important, there is much greater variability in the number of individual scales in the different rows. The number of scales in the two outer longitudinal rows, one above and below, is very variable, often consisting of only one scale, and such a row was also included in the count. Therefore, it is evident that the number of longitudinal rows represents only a very roughly approximate expression of the vertical extent of squamation.

The spaced scales in the row behind the pectoral base are often partly or wholly missing in preserved specimens, being more or less deciduous. However, when missing, the edge of the scale pocket may be readily raised with a dissecting needle, and the number of scales originally present in any given specimen may be thus ascertained. The distribution given in Tables 2 and 3 includes specimens so determined.

Sex differences.—Males and females differ in the extent of squamation, and it is necessary to separate data for scale characters by sex, as is done in Tables 2 and 3. This is a sex difference that is out of the ordinary in fishes. Table 1 also shows some average sex differences in fin-ray counts; but these differences are slight and their reality may be doubted. They may be due to vicissitudes of sampling.

Comparison.—*Garmannia schultzi* is very closely related to *G. spes*. The most divergent character separating them is the pectoral count. They overlap even in this character (Table 1) but the degree of divergence is high. Their index of divergence, using the measure proposed by me (Zoologica **13**: 253–279. 1938), is 92, which is of the magnitude of full species. The population represented by the holotype also differs to some extent from *spes* in the extent of squamation, but the Salina Rica population of *schultzi* nearly agrees with *spes* in this respect.

As there is no other widely divergent character to correlate with the pectoral count, single specimens usually can not be distinguished with certainty. If a specimen has 15 pectoral rays it almost certainly belongs to *spes*, and if it has 18 or 19 rays, it evidently belongs to *schultzi;* but

single specimens having 16 or 17 rays (these are the counts in which the majority of the specimens fall, 16 and 17 being the modal counts of *spes* and *schultzi*, respectively) can not be identified with assurance, and it is necessary to have a sample of 5 or 10 specimens for a satisfactory identification. For instance, in a sample of three specimens from the Ciénaga del Guanavana (see above), one had 16 and the other two 17 pectoral rays, and it is consequently most likely that this small sample belongs to a population of *schultzi*.

Populations.—Though it is true that they are relatively near one another geographically, the populations of *schultzi* represented by the samples examined apparently differ to a considerable extent morphologically. The differences in the extent of squamation, as expressed by the number of transverse and longitudinal rows and the number of spaced scales in the row behind the pectoral base, are shown in Tables 2 and 3. The small samples examined suggest that the population living 7 km below Maracaibo City diverges from the Salina Rica population, which is only 5 km above Maracaibo City, to a degree that may prove to be of subspecific magnitude when adequately larger samples are examined. Another difference between these two populations, which is also a result of the difference in the extent of squamation, is as follows: In the Salina Rica population the dorsal aspect of the caudal peduncle is partly or almost wholly scaled over, while in the population about 12 km farther south it is naked. The Salina Rica population also may possibly prove to average slightly fewer dorsal and anal rays (see Table 1), but such differences, if real, are evidently of very low degree.

The southernmost population of *schultzi* examined averages the least extent of squamation, consisting in some extreme variants, usually males, of virtually nothing more than a moderate elongate patch on the caudal peduncle. The population at the Yacht Club is, in general, morphologically about intermediate between the two populations compared above; but only one specimen out of seven has the dorsal aspect of the caudal peduncle scaled, being in this respect nearest the southernmost population.

The sample taken in a bayou near Sinamaica, which is referred to below to *spes*, is possibly just another closely related local population which, however, has diverged from the others to such a degree that it may be treated as a distinct species. This Venezuelan population is morphologically near enough to the Canal Zone population, originally described as *spes*, for the two to be treated taxonomically as belonging to one species. If this conjecture (that the Venezuelan sample of *spes* represents merely a highly divergent local population) is tenable, it follows that among these populations morphology is not always regularly correlated with geographic distribution. The population at the Yacht Club is geographically as well as morphologically intermediate between the populations north and south of it; but the population near Sinamaica, which is here referred to *spes*, is sandwiched in between populations that are sufficiently divergent from it to be properly placed in another species.

It should be added that the samples examined are not strictly comparable for size; the 34 specimens of *schultzi* from south of Maracaibo City are considerably smaller than most specimens in the other samples of the same species. However, the full adult squamation appears to be developed in specimens as small as 14 mm, and the differences outlined above are evidently population differences.

The ecological factors are not well enough known for one to discuss adequately, or speculate about, influence of environment on morphological diversification. The nature of the bottom does not seem to be decisive, as *schultzi* seems to inhabit both soft and hard bottoms (see above). All the populations referred to *schultzi* were taken in saline water, while the Venezuelan sample of *spes* was taken in fresh or nearly fresh water. However, the original sample of *spes* from the Canal Zone was taken in saline water also; consequently, salinity likewise does not seem to play a decisive role.

Garmannia spes Ginsburg

Garmannia spes Ginsburg, Journ. Washington Acad. Sci. 29: 62. 1939.

Sample collected in a caño [bayou] about $\frac{3}{4}$ km west of Sinamaica (the latter about 55 km north of Maracaibo City), Gulf of Venezuela; in thick vegetation on mud; nearly fresh water; L. P. Schultz; March 11, 1942; 52 males, 18–41 mm, 55 females, 15–27 mm, U.S.N.M. no. 121551.

As shown in Tables 1–3, the Venezuelan population represented by the above sample is close enough to the one from the Canal Zone for the two to be grouped in one species. As there are only three Canal Zone specimens available for comparison, the differences between the two populations can not be discussed at length. Very likely the Canal Zone population will prove to average a higher dorsal count, to what extent remains to be seen.

Morphological relationship of the species of Garmannia.—Seven species of *Garmannia,*

TABLE 1.—FREQUENCY DISTRIBUTIONS OF THE FIN-RAY COUNTS IN GARMANNIA SCHULTZI AND G. SPES

Population	Sex	Pectoral					Dorsal			Anal			
		15	16	17	18	19	10	11	12	8	9	10	11
schultzi:													
Below Maracaibo City....	♂	—	2	12	5	1	—	10	9	—	3	16	—
	♀	—	1	8	5	—	—	11	2	1	3	9	—
Yacht Club............	♂	—	—	4	—	—	—	3	1	—	—	4	—
	♀	—	—	1	1	—	—	2	—	—	—	2	—
Salina Rica............	♂	—	1	4	—	—	—	5	—	—	1	4	—
	♀	—	—	1	1	—	—	2	—	—	1	1	—
spes:													
Venezuela.............	♂	21	29	2	—	—	1	32	19	—	9	42	1
	♀	12	39	4	—	—	1	35	19	—	10	44	1
Panama...............	♀	—	3	—	—	—	—	1	2	—	—	3	—
schultzi:													
Total................	♂	—	4	20	5	1	—	19	10	—	4	25	—
	♀	—	1	10	7	—	—	15	2	1	4	12	—
Grand total...........		—	5	33	12	1	—	35	12	1	8	38	—
spes:													
Grand total...........		33	71	6	—	—	2	68	40	—	19	89	2

TABLE 2.—FREQUENCY DISTRIBUTION OF SCALE COUNTS IN MALES OF GARMANNIA SCHULTZI AND G. SPES

Population	Tranverse rows						Longitudinal rows				Number of scales behind pectoral		
	7	8	9	10	11	12	3	4	5	6	3	4	5
schultzi:													
Below Maracaibo City....	1	2	9	6	—	—	8	10	1	—	9	10	1
Yacht Club............	—	—	4	—	—	—	—	1	3	—	2	2	—
Salina Rica............	—	—	1	1	1	2	—	—	—	5	—	4	1
spes:													
Venezuela.............	—	5	16	15	2	1	2	10	24	1	21	28	3

TABLE 3.—FREQUENCY DISTRIBUTIONS OF SCALE COUNTS IN FEMALES OF GERMANNIA SCHULTZI AND G. SPES

Population	Transverse rows								Longitudinal rows					Number of scales behind pectoral				
	9	10	11	12	13	14	15	16	3	4	5	6	7	2	3	4	5	6
schultzi:............																		
Below Maracaibo City.......	3	2	1	5	1	—	—	—	3	4	2	3	—	—	2	9	3	—
Yacht Club............	—	—	—	—	1	1	—	—	—	—	1	1	—	—	—	1	—	1
Salina Rica............	—	—	—	—	—	2	—	—	—	—	—	1	1	—	—	1	1	—
spes:																		
Venezuela.............	—	—	2	4	13	15	4	1	—	—	23	20	1	—	6	25	18	6
Panama...............	—	—	—	1	1	—	1	—	—	—	1	1	—	1	1	1	—	—

namely, *hildebrandi, spilota, spes, homochroma, pallens, gemmata,* and *mediocricula,* have been described by me at different times during the past four years. Two other species, *Gobius chiquita* Jenkins and Evermann and *Gobiosoma macrodon* Beebe and Tee-Van, generally placed in other genera by authors, should also be included in *Garmannia.* The above species together with *paradoxa,* the genotype, and the one here described, *schultzi,* constitute a total of 11 species now known, which are comprised within the limits of *Garmannia.* Other species hitherto placed by authors in *Garmannia* apparently should be transferred to other genera. (*Gobiosoma digueti* Pellegrin, inadequately described, the type of which is presumably in the Paris Museum and has not been examined by me, possibly also belongs to *Garmannia.*) It is, therefore, timely to give a short resume of the genus.

The 11 species of *Garmannia* show differences of varying degrees, some of them diverging widely in their morphological characters as compared with others. In order to display prominently the divergences for taxonomic purposes the genus may be divided into a number of subgenera, as follows:

Subgenus **Tigrigobius** Fowler

Tigrigobius Fowler, Proc. Acad. Nat. Sci. Philadelphia **83**: 401. 1931.

Genotype: *Garmannia macrodon* (Beebe and Tee-Van) = *Gobiosoma macrodon* Beebe and Tee-Van (Zoologica **10**: 226. 1928).

Besides the genotype, *pallens* is also referrable to *Tigrigobius.* This subgenus differs from all others in the dentition of the upper jaw. The outer row of teeth ends about midway between the symphysis and the angle of the mouth and the last tooth in the row is caninoid, appreciably larger than the teeth anterior to it. The maxillary is rather long, attaining approximately to the posterior margin of the eye. The head is strongly compressed. The squamation covers about the posterior third of the body in *pallens* and is reduced to a small patch on the caudal peduncle in *macrodon.* The color pattern is sharply cross-banded in *macrodon,* more moderately so in *pallens.*

Gobicula, n. subg.

Genotype: *Garmannia gemmata* Ginsburg (Smithsonian Misc. Coll. **98** (14): 3. 1939).

This monotypic subgenus is nearest to *Tigrigobius,* nearly agreeing with it in the backward extension of the maxillary and the head shape. It differs in the dentition of the upper jaw, which, as in the other subgenera, except *Tigrigobius,* has the teeth in the outer row extending nearly to the angle of the mouth and the posterior teeth are somewhat smaller than the anterior ones. The squamation is confined to the caudal peduncle. The cross-banded color pattern is obsolescent.

Gobiolepis, n. subg.

Genotype: *Garmannia hildebrandi* Ginsburg (Journ. Washington Acad. Sci. **29**: 62. 1939).

Besides the genotype, *chiquita* and *spilota* are also referable to *Gobiolepis.* This subgenus differs, in general, from the others, except *Gobiculina,* in the greater extent of squamation, although the division is not sharp when all the species are considered. The squamation on the midline extends all the way forward nearly to the pectoral base. In *hildebrandi* the anterior squamation, in the area anterior to the second dorsal, is much reduced, consisting largely of a rather narrow band of scales on the midline; in *chiquita* nearly the entire body is scaled over; while in *spilota* the squamation is about intermediate between that of the preceding two species. The maxillary ends under the posterior margin of the pupil or middle of eye. The head is depressed or subterete. The color pattern is diffusely cross-banded or no cross-bands are evident.

Subgenus **Garmannia** Jordan and Evermann

Garmannia Jordan and Evermann, Proc. California Acad. Sci. (2) **5**: 497. 1895.

Genotype: *Garmannia paradoxa* (Günther) = *Gobius paradoxus* Günther (Proc. Zool. Soc. London, 1861: 372).

Besides the genotype, *mediocricula,* which was described from two specimens in rather indifferent condition, probably also belongs to the subgenus *Garmannia.* This subgenus differs from all others, except *Gobiohelpis,* in having the fourth transverse row of cutaneous papillae on the cheek interrupted instead of continuous. The head and maxillary are about as in *Gobiolepis.* The squamation closely approaches that of *Gobiolepis,* but it is not quite so extensive. The posterior half of the body is scaled over; the anterior half is either naked or a median

row of nonimbricate or overlapping scales is present, sometimes a second incomplete row.

Gobiohelpis, n. subg.

Genotype: *Garmannia spes* Ginsburg (Journ. Washington Acad. Sci. **29**: 62. 1939).

This subgenus comprises *spes* and *schultzi*. It differs from all other subgenera in lacking a transverse row of scales on the caudal base. In other characters it nearly agrees with the subgenus *Garmannia*.

Gobiculina, n. subg.

Genotype: *Garmannia homochroma* Ginsburg (Journ. Washington Acad. Sci. **29**: 62. 1939).

This monotypic subgenus differs from all others in having a small barbel below the anterior nostril, a very long maxillary which extends somewhat behind the eye, at least in the male, and a markedly depressed head. The extent of squamation is about as in *Gobiolepis*.

Remarks.—The above is a brief outline of some of the characters, which omits for the sake of brevity some other pertinent but less well marked characters. There are apt to be differences of opinion regarding the taxonomic status of the subgenera established, depending on the prevalent taxonomic practice in different groups of living things, or on the ideas of individual taxonomists. According to usage now common in American ornithology, for instance, these subgenera should perhaps be raised to full generic rank, for the degrees of morphologic divergence between them is approximately of the same magnitude as that between closely related groups of species of birds, which are often recognized by American ornithologists as full genera. Also, according to the standards used by some individual ichthyologists the above subgenera should be treated as full genera. However, the essential object of displaying prominently the marked morphologic divergence between the groups of species is attained equally well by segregating them into subgenera as into full genera. On the other hand, convenience is best served by the taxonomic treatment here proposed of considering them as subgenera. In the practice of taxonomy it is much more convenient to have fewer and larger genera.

GRANTS IN AID

The Washington Academy of Sciences has been allotted certain moneys from the Academy Grants Fund of the American Association for the Advancement of Science for the purpose of making grants in aid to young and promising scientists who have worthwhile research projects but lack the funds to continue work on them. The funds may be applied to the purchase of necessary equipment or supplies, but they are not to be used toward publication costs. The typing of manuscripts is considered as being related to publication and payment for such work is not regarded as justifiable assistance. The recipient of a grant is required to make progress reports on blank forms furnished by the American Association for the Advancement of Science.

The Washington Academy of Sciences now has $350 available and is prepared to receive applications for grants in aid up to the total of that sum. Grants may be made to one or more individuals, depending upon the amounts asked for and providing the total does not exceed $350. Application may be made by any member of the Academy or one of its affiliated societies. Letters describing the nature of the project and the amount of the desired grant should be addressed to the Secretary of the Washington Academy of Sciences, Dr. Ferdinand G. Brickwedde, National Bureau of Standards, Washington 25, D. C., and should be in his hands not later than February 1, 1945.

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Volume 34 December 15, 1944 No. 12

ETHNOLOGY.—*The Delaware Indians as women.*[1] C. A. Weslager, Archaeological Society of Delaware. (Communicated by William N. Fenton.)

Among the strange concepts in the social symbolism of the American Indian tribes of the East was the treatment accorded a vanquished enemy group by the victors. We have heard much repeated, analyzed, and even contradicted accounts in a century and a half of historical literature concerning the relationship between the Five Nations Iroquois and the Delaware Nation, culminating in the degradation of the latter. The Five Nations relegated the Delaware to a position of "women" by applying the symbolic attributes of the female to them as a nation of women, devoid of political or military power. This subjugation and lowering of status of the enemy were linked with sexual connotations, real and symbolical, which are fraught with mystery and which placed the Delaware tribe in a subservient social position. As women they could not go to war or negotiate peace treaties. In fact, their entire political organization by this act of humiliation was deprived of masculine prerogatives. They were compelled to accept the chiefs of the Iroquois Confederacy, the League of Five Nations, as their spokesmen, agents and overlords in the political family of nations.

Loskiel, the Moravian historian, was among the first contemporary observers to call attention in print to the Delaware in their status as women. The story related to him either directly by Delaware informants, or more probably to him through his fellow missionary Heckewelder, was that in the distant past the Five Nations met with the Delaware and convinced them that it was senseless for the Indians to war against each other as they had been doing. The Five Nations proposed, therefore, that the Delaware tribe accept an honorable, noncombatant position as peacemakers. In such a role they would not engage in combat and consequently as a neutral party could negotiate peace between warring tribes. The right was one that belonged to the "tribal matrons" as the position accorded women was regarded in their social policies, who could with impunity propose cessation of hostilities to their men fighters. Such subterfuge would permit their warriors to "save face," since it would not be necessary for either of them to sue for peace. Yet both would be spared further bloodshed. The Delaware, so their story went, accepted this respected position as matrons. During a ceremony that marked the occasion, the Iroquois, according to the Delaware version, are supposed to have said: "We dress you in a woman's long habit reaching down to your feet and adorn you with earrings," meaning that they should not take up arms again. "We hang a calabash filled with oil and medicine on your arms," meaning that they should use the oil to clean the ears of those who could not distinguish good from evil, and also use the medicine to heal those walking in evil. "We deliver unto your hands a plant of Indian corn and a hoe," meaning that they should thereafter be as women.[2]

Later the Delaware claimed that they had been duped, their independence forfeited, their autonomy humiliated. After accepting the pact in good faith, they said that they found they had sacrificed their individual rights and the Five Nations were exploiting them and that they were helpless

[1] Received October 4, 1944.

[2] G. H. Loskiel, *History of the mission of the United Brethren*, etc.: 126. London, 1794.

to retaliate, having obligated themselves by their sacred word of honor which could not be broken.

The Five Nations told an entirely different story. They averred that the Delaware version was a complete fabrication to win sympathy. They maintained they had conquered the Delaware fairly in open battle and as a penalty had reduced them to the disgraceful position of women. Thus the impartial observer has found himself faced with two opposing views and is at a loss to settle on the correct one. Zeisberger[3] presents the two sides to the controversy as does Heckewelder,[4] although the latter's conclusions are that the Delaware story was the authentic one. He deduced from information given him that the Dutch had instigated the scheme to weaken the Delaware.

Morgan claims that it is true that the Five Nations defeated the Delaware and that the latter acknowledged their dependence by sending tributary wampum but were not then reduced to womanhood. However, Morgan says that while the Delaware were under the protection of the Five Nations they made inroads upon a western nation also under Five Nations dominance. To punish the Delaware for their unauthorized conduct a deputation of Iroquois chiefs went among them and degraded them from the rank of a tributary nation to that of women. Morgan unfortunately does not give us the source of his information. He makes an obvious error by stating that the Delaware "never emancipated themselves after this act of denationalization," as we shall shortly see.[5]

Brinton devotes a chapter to the Delaware as women but touches only superficially upon the historical events from 1754 to 1758, when the relationship between the Delaware tribe and Five Nations reached its climax and when the details of the feminization stand out in clearer perspective. Brinton says that the feminizing occurred around 1725 and that the Five Nations made the Delaware as women in consequence of their refusal to join in an attack on the English settlements. This explanation is based entirely on an interpretation given him by Shawnee informants but is not tenable, for the Five Nations were long known to be pro-English.[6]

The writer has had the good fortune to uncover hitherto unrecognized sources in the Provincial Records of Pennsylvania regarding the Delaware as women. The references at hand do not entirely explain but they add measurably to our understanding of this little known and much debated diplomatic contention.

Early in colonial history, the Five Nations (later known as the Six Nations) assumed a position of dominance over the Indians living in the Delaware and Susquehanna River Valleys.[7] After defeating the Susquehannock Indians, they seized control of the Susquehanna Valley and appointed their agent Shikellamy to supervise the affairs of the Susquehannock as well as the Shawnee, Conoy, Nanticoke, and others who had lately settled in the region by their invitation.[8]

As a result of white intrigue in land sales and the pressure exerted by the Five Nations, the Delaware Indians, who had formerly occupied eastern Pennsylvania, New Jersey, and the northern parts of Delaware as a solid nation, began to experience political disintegration. By 1712 some remained in New Jersey; a larger body of

[3] *David Zeisberger's History of the Northern American Indians*, ed. by A. M. Hulbert and W. N. Schwarze. Ohio State University, 1910.

[4] John Heckewelder, *History, manners and customs of the Indian Nations.* Historical Society of Pennsylvania, Philadelphia, 1876.

[5] Lewis H. Morgan, *League of the . . . Iroquois:* 328–329. New York, 1922.

[6] D. G. Brinton, *The Lenape and their legends.* Philadelphia, 1885.

[7] For a summation of the Iroquois and their historical position, see William N. Fenton, *Problems arising from the historic northeastern position of the Iroquois*, Smithsonian Misc. Coll. 100: 159–251. May 1940.

[8] The present author discusses the subjection of the Nanticoke in *The Nanticoke Indians in early Pennsylvania history*, Pennsylvania Mag. Hist. and Biogr., Oct. 1943: 345–355. Additional data are presented in an essay, *The Nanticoke Indians, their emperors and estates*, to be published soon by the Historical Society of Delaware.

For a discussion of the absorption into the League of these subjected tribes see Frank G. Speck, *The Nanticoke and Conoy Indians.* Historical Society of Delaware, 1927.

Munsee affiliation was settled at the forks of the Delaware near present Easton; some were living on the Schuylkill River; and a few families remained on the upper Brandywine. Others had moved west and were living on the Susquehanna, and some had even straggled farther west to establish themselves in the Allegheny Valley at Kittanning.

In May, 1712, Sassoonan, also called Allumapees, and Skalitchy, chiefs of the Unami Delawares, met with the Pennsylvania governor and acquainted him that "many years ago being made tributary to the Mingoes or 5 Nations and being now about to visit them," they deemed it proper to show the governor the tribute they were carrying to their overlords. It consisted of 32 belts of wampum. The chiefs also exhibited a pipe with a stone head, which had been given them by the Five Nations who, they frankly admitted, "had subdued them and obliged them to be their tributaries."[9]

This is an important reference because it is the earliest admission appearing in the public documents, by the Delaware themselves, that they had actually been subdued by the Iroquois. Two years later Sassoonan said in another conference that the "Five Nations had often told them that they were as Women only and desired them to plant corn and mind their own private business for that they [the Five Nations] would take care of what related to war and peace."[10]

By 1742 the Delaware Indians remaining at the forks of the Delaware near Easton demanded that the English make restitution for the lands which they had confiscated, especially in the fraudulent "walking purchase" of 1737. The English produced deeds to prove that they had paid for the lands. The controversy reached its climax at a meeting held on July 12, 1742, with the Pennsylvania authorities. Also present were Canassatego and Shikellamy representing the Five Nations; Sassoonan representing the Unami Delawares then living at Shamokin; and Nutimus and other chiefs representing the Delaware Munsi living at the forks whose lands were the point at issue.

At this meeting Canassatego made a speech, now famous in Indian history. He upbraided these Delaware chiefs unmercifully for questioning the words of "their fathers," the English, and then he said:

"But how came you to sell land at all? We conquered you, we made Women of you, you know you are Women, and can no more sell land than women. . . . We therefore assign you to two places to go, either to Wyomon or Shamokin. You may go to either of these Places, and then we shall have you more under our Eye and shall see how you behave."[11]

He forthwith seized the Delaware speaker by the hair and forced him out of the council room. Canassatego, as we have reason to believe, may have conspired with the English to rid the land of the Delaware, but the fact remains that his accusation of the Iroquois having made the Delaware as women *through conquest* stood without refutation.

Two bands of Delaware, humbly yet reluctantly, settled at the two assigned villages under the vigilant eye of Shikellamy, the Five Nation agent. In a short time, some of them moved farther west to join the growing bands of the Allegheny under the leadership of the two brothers, Chief Beaver and Chief Shingas.[12] Sassoonan remained on the Susquehanna River with

[9] *Minutes of the Provincial Council* **2**: 546. This set of records on which most of this essay is based will be referred to hereafter as "Minutes." It was issued in 16 volumes, under the full title, *Minutes of the Provincial Council of Pennsylvania*, published by the State. Volumes 1, 2, and 3 were printed by Jo. Severns & Co., Philadelphia, 1852. Volumes 4 to 16, inclusive, were printed by Theo. Fenn & Co., Harrisburg, 1851–1852.

[10] Minutes **3**: 334. Sassoonan is believed by some historians to be a son of the famous Tamanend.

[11] Minutes **4**: 578. As we know today, Wyomon, or Wyoming, was on the north branch of the Susquehanna River near present Wilkes Barre, Pa. Shamokin was near the present site of Sunbury, Pa.

[12] C. Hale Sipe, *Indian wars of Pennsylvania*: 276, Harrisburg, 1929, points out that they were brothers. Beaver's son Peter later became a renegade leader of some of the Delaware; see Minutes **7**: 381. Shingas and Beaver are believed to have been nephews of Sassoonan, and thus descendants of the great chief Tamanend. Like Tamanend, they were members of the Turkey Clan.

others of his tribe until the time of his death about 1748.[13] For a time following his death, the Delaware were without a national leader. Finally, from the village Wyoming, a new figure arose to lead them, a chief who was to become one of the greatest Delaware sachems of all time—Tedyuskung, or as he was called in English, Honest John.[14] In 1755 he was acknowledged by the Five Nations as the Delaware "king."[15]

With the changes in Indian political life, there were also transitions taking place among the whites which must be given due attention for a full understanding of Indian relations. By 1754 the situation in colonial affairs was as follows:

The French and English had crossed paths in the New World and were about to declare war on each other. The Five Nations allied themselves with the English, promising the assistance of the tribes then under their domination, including Delaware, Nanticoke, Conoy, Shawnee, Twightwee, and Susquehannock (called Conestoga). The French, in turn, were doing their utmost to incite the Indians to arise and join them in an attack on the English. The French were especially determined to gain control of the Ohio Valley and its tributaries, and sent their emissaries to contact the Delaware and Shawnee living there and solicit their aid. They threatened the Indians with extinction if they did not join them in warring against the English. Out of this crisis, well recorded by colonial scribes, we can see the Delaware breaking their feminine shackles. In 1754 one of the Delaware bands sensing they were in jeopardy sent the following message to the Five Nations; the italics are mine:

"Uncles the United Nations. We expect to be killed by the French your fathers; we desire, therefore, *that you will take off our petticoat that we may fight for ourselves*, our Wives and Children; in the condition We are in you know we can do nothing."[16] Their "condition" as women meant that they were unable to protect themselves.

The Delaware chief Beaver also addressed himself to the Five Nations as follows; the italics are mine:

"Uncles: *I still remember the time when you first conquered us and made Women of us* and told Us you took Us under your Protection and that we must not meddle with Wars but stay in the House and mind Council affairs. We have hitherto followed your directions and lived very easy under your Protection, and no high Wind did blow to make us uneasy, but now things seem to take another turn and a high wind is raising. We desire you, therefore, Uncles, to have your eyes open and watchful over us, your Cousins, as you have always been heretofore."[17]

Tedyuskung, speaking at a council meeting with the English in 1755, voiced a hope that the Delawares would eventually be emancipated from womanhood when he said:

"Tho our Uncles have made Women of Us, yet in time to come We may have children, who when born, may look up and see the Sun and Sky clear and the Roof open between Us and You; and we will advise them to take and always continue to hold fast by the middle of that Chain as their ancestors have done before them."[18]

After Braddock's defeat by the French and Indians, there was terrible bloodshed on the Pennsylvania frontier. The Delaware, still angered at the confiscation of their lands by the English and goaded on by the French, joined the Shawnee and deserted the English interests. They allied with the French, detached themselves from their dependence on the Five Nations, and went on the warpath. They burned many

[13] Minutes **5**: 222 state that the Delawares in 1748 were looking for a proper person to succeed "Olomipas, the King of the Delawares lately deceased." In Vol. 7, p. 726, it is brought out that he was of the Unami, the "sub-tribe" who claimed hereditary chieftainship over the other Delawares, according to Brinton, *op. cit.*

[14] Sipe, *op. cit.*, p. 262, says that Tedyuskung was the son of John Harris and was born in Trenton, circa 1705. This is corroborated in Minutes **7**: 359, where it is stated that he had moved from New Jersey to Wyoming. Also in Vol. 7, p. 220, it is noted that Tedyuskung had three sons, Amos, Kesmitas, and John Jacob. Later we see that a chief named Captain Bull was termed a son of Tedyuskung. Heckewelder, *op. cit.*, p. 302, says that Tedyuskung joined the Indian Christian congregation in 1749 and was baptized and given the name Gideon.

[15] Minutes **7**: 199.

[16] Minutes **6**: 36.

[17] Minutes **6**: 155.

[18] Minutes **6**: 363.

homes, scalped settlers, and took scores of women and children prisoners. They revealed themselves as ruthless warriors and not the peaceful women they were reputed to be.

The Five Nations sent an ultimatum to the Delaware to cease hostilities against the English with whom the Five Nations were then more closely allied than ever before. The Delaware refused flatly and replied as follows to the message from their overlords; the italics are mine:

"We are men and are determined not to be ruled any longer by you as Women; And we are determined to cut off all the English except those that may make their escape from us in Ships. So say no more to us on that Head, *lest we cut off your Private Parts and make Women of you as you have done of us.*"[19]

The English, with the endorsement of the Five Nations, subsequently declared war on the Delaware, offering bounties for their scalps. Here followed a period of conflict that does not now concern us.

By 1756, however, the Delaware repented having attacked the English, and Tedyuskung opened negotiations with the English for a permanent peace and a satisfactory settlement of the land disputes. The Five Nations then aware that the Delaware were no longer willing to remain in the inferior position of women felt it expedient to allow them more latitude. Tedyuskung appeared before the Pennsylvania Council in July of 1756 and exhibited a wampum belt. "This belt," he said, "denotes that the Six Nations by their chiefs have lately renewed their covenant chains with us; formerly we were Accounted Women, and employed only in Women's business, but now they have made men of us and as such we now come to this Treaty having the authority as a Man to make peace."[20]

Tedyuskung exaggerated when he claimed that the Iroquois had made them completely men, for it was a masculinity with the specific reservation that the Delaware refrain from making war. In fact, the wampum belt sent to Tedyuskung by the Iroquois, which he exhibited, had been accompanied by the following significant message:

"Cousins, the Delaware Indians: You will remember that you are our women; our forefathers made you so, and put a petticoat on you and charged you to be true to us and lie with no other man. But of late you have Suffered the string that tied your petticoat to be cut loose by the French and you lay with them and so became a common bawd, in which you did very wrong and deserve Chastisement, but notwithstanding this, we will still Esteem you, and as you have thrown off the Cover of your modesty and become Stark naked which is a shame for a woman, we now give you a little Prick and put it into your Private Parts, and so let it grow there till you shall be a compleat man. We advise you to act as a woman yet, But be first instructed by us, and do as we bid you and you will become a noted man."[21] Thus did the Five Nations express themselves as willing to have the Delaware eventually rate full manhood provided they followed their bidding. They were reluctant to relinquish a control they had exercised over the vanquished tribe for many years, but they realized they were now dealing with warriors who might suddenly turn against them as they did against the English.

The Pennsylvania governor, desirous of verifying Tedyuskung's standing, sent an Iroquois messenger named New Castle to confer with the Five Nation chiefs to appraise the status of the Delaware. New Castle conferred with several sachems, including Canyase, a Mohawk chief and one of the principal counselors of the League. Canyase admitted having had a long discourse with Tedyuskung, at which time he reminded him that the Delaware were women, and in attacking the English had behaved in a manner not becoming to their condition. "But," Canyase had said to Tedyuskung, "since you have been so foolish as to obey that voice, a Stranger's voice and cut off your Pettycoats and taken the Tomahawk and now appear in the Character of a Man. I join and help to cut off your Pettycoats, and so far make a Man of you, but I do not put the Tomahawk in

[19] Minutes 7: 522.
[20] Minutes 7: 213.
[21] Minutes 7: 218.

your hand. I know what is for your good and therefore I will not allow you to carry a Tomahawk."[22]

Having had his figurative skirts removed, Tedyuskung's position was strengthened, and he embarked on a program to consolidate the Indians. Within a short time he claimed to be not only the "king" of the Delaware but a "spokesman" empowered by ten nations, namely, "the Lenopi, Wenami, Munsey, Mahickon, Tiawaco or Nanticokes, Senecas, Onandogas, Cayugas, Oneidas and Mohawks."[23] Furthermore, his position was strengthened when he was appointed by the English as one of their Indian agents, and in his dealings he was assisted by Charles Thompson, a Philadelphia Quaker and a champion of Indian rights, who served as the chief's secretary in some of the conferences with the whites.[24]

At a council meeting with the Pennsylvania authorities held at Easton, Tedyuskung announced that he was now a man. He said (the italics are mine):

"Now you may remember I was stiled by my uncles the Six Nations a Woman in former years and had no hatchet in my hand, but a pestle or Hominy pounder. But now, Brethren, *here are some of my Uncles, who are present to witness the truth of this;* as I had no Tomahawk and my Uncles were always stiled Men and had Tomahawks in their Hands, they gave me a Tomahawk. And as my Uncles have given me a Tomahawk and appointed and authorized me to make peace with a Tomahawk in my Hand, I take that Tomahawk and turn the edge of it against your enemies, the French.[25]

Thus, by diplomatic negotiation, Tedyuskung placed the Five Nations in the position of being forced to recognize the Delaware as men. If they refused to give them the tomahawk and prohibited them from fighting, it would displease the English and make it appear that the Five Nations were unwilling to support the English cause with all their resources.

Those of his "uncles" whom Tedyuskung offered in witness to the statement that he was now a man were not members of the Great Council but young Iroquois braves who had no authority to speak for their elders, although the English seemingly were not fully aware of this.

At a subsequent conference in 1758, a delegation of *bona fide* Five Nations chiefs, angered at Tedyuskung's self-imposed authority, demanded to know who gave him the authority he claimed. For a moment, his fate hung in the balance, and the fate of the Delaware as a whole, but having won the confidence of the English and of his own people, he managed to retain his position of importance. He was also shrewd enough when confronted by his Iroquois critics to answer that while he was a chief of the Delaware he was only a humble messenger of his "Uncles and Superiors."[26] Nevertheless, he had effectively severed the bonds of womanhood, even though the Delaware continued to rely on the Five Nations for advice and to respect their wishes. The Five Nations, in turn, no longer commanded the Delaware, but on one occasion "asked" as their indulgent uncles that they return the English captives they had taken during the earlier frontier incidents.[27]

It is also significant that the Delaware's emancipation from the Five Nations was known and accepted by other tribes, as evidenced in a note sent to Tedyuskung in

[22] Minutes **7**: 297. New Castle's Indian name was Cashiowayah. He succeeded Scarroyady who succeeded Shikellamy as the Iroquois agent over the tributary tribes.

[23] Minutes **7**: 665. Tedyuskung's genius is evidenced in the adroit way he renewed friendship with the English after the frontier massacres, and at the same time outsmarted the Five Nations. That he exercised authority he did not rightfully possess must now be admitted, although it was then not known to the English. In 1758 he said that eight more nations had joined the ten he already represented, namely, "Ottawas, Twightwees, Chippewas, Toawaws, Caughnawagos, Mahoowa, Pietoatomaws, and Nalashawwna." See Minutes **8**: 33.

[24] Minutes **7**: 664. Tedyuskung was probably the first Indian chief to appear at a meeting with his own secretary to make a written record of the transaction. The whites usually were the only party of the contract who had a written record, and this obviously placed them in an advantageous position, because the Indians were forced to trust to memory. See also Charles Thompson, *An inquiry into the causes of the alienation of the Delaware and Shawnee Indians.* Philadelphia, 1867.

[25] Minutes **7**: 710.

[26] Minutes **8**: 191–192.

[27] Minutes **8**: 194.

1758 by the Cherokee in which this excerpt appears. "*Formerly*, you used to Wear a petticoat and did not go to war, etc."[28] Nevertheless, the reader must not gather the impression that all of the Delaware were immediately relieved of the pressure from the Five Nations. The tribe at that time was widely scattered, and some of the outlying Munsee bands continued to be dominated by the Seneca. In May, 1758, a Seneca chief reported in a conference with the whites that the "Munseys are Women and can not hold treaties for themselves."[29] The Munsee, as we know today, were affiliates of the Unami, or Delaware proper, but like the Mahican were a separate political entity.

Tedyuskung's decease, a sudden and irreparable loss to the Delaware, was a tragic one. On April 16, 1763, he was burned to death in a fire which razed his cabin at Wyoming. It is said that the old chief was in a drunken stupor and that the Five Nations started the fire with the deliberate purpose of killing him.[30]

During the Revolution the Five Nations continued in their alliance with the English, whereas most of the Delaware went over to the American cause. In 1775, at a meeting in Pittsburgh, the Seneca made a final effort to win the Delawares over to their side, and reminded them that they had once been women. The Seneca had apparently never reconciled themselves to the fact that the Delaware had regained their manhood, nor publicly admitted it. The Delaware chief, Captain White Eyes (Koquethagechton of the Turtle Clan) replied as follows to the insinuation:

"You say that you had conquered me, that you had cut off my legs—had put a petticoat on me, giving me a hoe and corn pounder in my hands saying: 'Now woman! Your business henceforward shall be to plant and hoe corn and pound the same for bread for us men and warriors.' Look at my legs! If as you say, you had cut them off, they have grown again to their proper size!—the petticoat I have thrown away, and have put on my proper dress; the corn hoe and pounder I have exhanged for these firearms and I declare that I am a man."[31]

In 1779 the Delaware under the leadership of Captain White Eyes joined Colonel Daniel Brodhead in an expedition against the Seneca. Thus they showed their contempt even more eloquently than in words. After White Eyes' death, some of the Delaware were persuaded by Captain Pipe, another Delaware chief, to go over to the British side, and once more they were allied with their former Iroquois overlords. In the upheaval in the Indians' social and political organizations during the Revolution, it is exceedingly difficult to find either continuity or consistency in their behavior.

In 1794, shortly before the treaty of Greenville, the Five Nations delegates came forward to declare officially that the Lenape (Delaware) were no longer women but men, and the famous chief Joseph Brant formally placed in their hands the war club.[32]

CONCLUSIONS

Without presuming to add finality to the question of the Delaware as women, we can draw from our data, which contain specific admissions by Delaware speakers of their defeat, that the Five Nations feminized the Delaware prior to 1712 through conquest. Between then and 1756, the Five Nations treated the Delaware contemptuously, prohibiting them from going to war or making treaties. Following Braddock's defeat the Delaware went on the warpath against the English, refusing to accede to the demands of the Five Nations that they lay down their arms. Under the leadership of Tedyuskung, the Delaware by 1756 declared that they were not women and forced the Five Nations to accept them on new and more liberal terms. However, the Five Nations did not then grant them complete manhood and withheld granting them permission to go to war.

[28] Minutes **8**: 136.

[29] Minutes **8**: 158.

[30] GEO. P. DONEHOO, *in* Hodge, F. W. (Ed.) *Handbook of American Indians*, Bur. Amer. Ethnol., Bull. 30, **2**: 714–717. 1910.

[31] JOHN HECKEWELDER, *Narrative of the mission of the United Brethren among the Delaware and Mohegan Indians:* 140–141. Philadelphia, 1820.

[32] HECKEWELDER, *op. cit.:* 70; SCHWEINITZ, *Life of David Zeisberger:* 430, 641.

During the Revolution, the Delaware denied they were in any way under Five Nations' domination and joined the colonists in fighting the English and their Five Nation allies. Finally, as an anticlimactic gesture, at the close of the Revolution, the Iroquois conceded that the Delaware were no longer women but men.

In the sexual symbolism of the feminizing, we recognize unfathomed depths in native philosophy. Whether the figurative deprivation of the Delaware of their male accoutrements, both physiological and cultural, had its origin in literal practices remains unknown. Brinton claims, quoting Hammond, that young men of some of the western tribes were deprived of their virility, clothed like women, and assigned to women's work.[33] The institution of the berdache or transvestite was widespread among American tribes, which attests to its antiquity, and it is well known from the Plains. However, the feminizing of the Delaware, which follows similar lines of thought, is the outstanding recorded instance of its kind in the East. It is probably the only time that the rite was so institutionalized as to affect the status of an entire tribal group.

[33] Brinton, *op. cit.:* 110.

PALEONTOLOGY.—Thyridocrinus, *a new inadunate crinoid genus from the Silurian.*[1] EDWIN KIRK, U. S. Geological Survey.

In 1908, Slocum described a crinoid from the Niagaran of Illinois as *Achradocrinus patulus*. This is the first recorded occurrence of a crinoid referable to the family Gasterocomidae in the Silurian. In 1926, Springer described a crinoid from the Middle Silurian of Tennessee, which he placed with doubt in the genus *Lecythiocrinus*. He specifically states that the form could not be referred to the Gasterocomidae. In the present paper both of these species are included in a new genus *Thyridocrinus*, which is placed in the Gasterocomidae.

Thyridocrinus, n. gen.

Genotype.—Lecythiocrinus? *problematicus* Springer.

Only the theca is known, but this is in an excellent state of preservation. Both species referred to the genus are small.

Dorsal cup. Low, broadly turbinate, composed of very heavy plates.

IBB. Three elements. The unfused *IB* is right-posterior in position.

BB. Small, except the posterior, which is considerably larger than the others in the type species. In the type species the distal face of *post B* forms the lower margin of the exposed lateral opening. In *T. patulus* a plate is interposed between *post B* and the opening.

RR. Large, with very large articulating faces. The arms must have been very heavy and directed nearly horizontally outward, closely simulating *Arachnocrinus*. The articulating face is pierced by a submedian axial canal. The distal portions of the radials form a broad shelf, leaving a relatively small area to be covered by the tegminal plates. The two posterior radials meet above the lateral opening.

Post IR. As noted above, in the type species the lateral opening is bounded below by the *post B*. In *T. patulus* a plate rests on the truncated distal face of *post B*, and this in turn forms the lower margin of the lateral opening. The significance of this plate and the nature of the lateral opening will be discussed later.

Tegmen. The greater part of the tegmen consists of a somewhat elevated rosette of irregularly disposed plates. At a lower level, between the rosette and the inner margins of the radials, are small groups of tegminal plates lying in the interambulacral areas. Each interambulacral area has from one to three of these plates. The rosette consists in the main of five orals. The posterior oral is large and is probably a madreporite, although pores cannot be made out with certainty. Radiating from the periphery of the rosette and covering the ventral groove of each radial is a double row of covering plates

[1] Published by permission of the Director, U. S. Geological Survey. Received August 30, 1944.

having a biserial arrangement. These doubtless extended outward, covering the ventral groove of the arm.

Column. Lumen circular, as judged by the perforation of the *IBB*.

Geological range.—*Thyridocrinus* is known at present only in the Middle Silurian of Illinois and Indiana.

Species referred to the genus.—

Thyridocrinus problematicus (Springer), n. comb.

(?) *Lecythiocrinus problematicus* Springer, 1926, p. 133, pl. 31, figs. 11, 11a, 11b: "Laurel limestone, Niagara, St. Paul, Indiana."

As photographed and described by Springer the type specimen of *T. problematicus* had the infrabasals intact. When first seen by me the specimen was mounted, base down, on a bit of plasticine affixed to a strip of light cardboard. Upon detaching the specimen it was found that the *IBB* were missing. The contact faces of the surrounding basals are perfectly clear and show that the arrangement of the *IBB* was that described and figured by Springer. The one missing structure is the lumen.

Thyridocrinus patulus (Slocum), n. comb.

Achradocrinus patulus Slocum, 1908, p. 288, pl. 85, figs. 1–4: "Clay pockets of the Niagara limestone at Romeo [Illinois]."

Elsewhere, pages 273–275, Slocum explains that these silicified fossils found at Romeo came from postglacial clays filling erosion channels in the Niagaran dolomite. The original source of the crinoid and associated fossils was a limestone near Lemont, Ill., some 5 miles distant. This limestone in place yielded a fauna that Slocum considered very much like that of the Silurian at St. Paul, Ind. (Laurel limestone).

Slocum's reference of his species to *Achradocrinus* is quite understandable but can not be maintained. Shultze's figures of *Achradocrinus ventrorsus* (1866, pl. 12, figs. 6, 6a) could be interpreted as showing the radial facets pierced by axial canals. His diagram, page 101 (213), fig. 19, and his description on the same page unequivocally indicate the presence of such canals. The actual type specimen (M.C.Z. 1238) shows that such is not the case, however. The specimen has been treated with acid, but the dark matrix filling the ventral grooves of the radials has not been removed in some cases. It is clearly shown that there is a deep, fairly narrow, open groove without a separate axial canal. Again, the articulating facets of the radials are small and quite unlike those of *Gasterocoma* or *Thyridocrinus*. Incidentally, the lumen of the column is pentagonal.

T. patulus agrees well with *T. problematicus* except for the presence of the supplementary plate in the *post IR*. This will be discussed later. Slocum (p. 288) assumed anchylosis of the *IBB*. In closely united circlets of plates the presence or absence of sutures is often a matter of personal opinion, and in silicified specimens such as this usually no sound judgment can be formed.

Relationships.—The most obvious difference between *Thyridocrinus* and *Gasterocoma* is the possession of three infrabasal elements in the former as against the anchylosed circlet in the latter. The well-defined rosette of apposed orals of *Thyridocrinus* is quite at variance with any known tegminal structure in species referred to *Gasterocoma*. The apparently circular columnar lumen of *Thyridocrinus* as judged by the perforation of the *IBB* is quite unlike the quadripartite perforation of *Gasterocoma*. As to the presence of peripheral canals in *Thyridocrinus*, no information is to be had.

Remarks.—Springer (1926, p. 133) recognized a "superficial resemblance" of his species to the Gasterocomidae but stated that "it is definitely excluded from them by its lack of undivided infrabasal disk and peripheral axial canals." On the contrary, the form seems to be linked closely to the Gasterocomidae and furnishes a logical Middle Silurian ancestral structure for the Middle Devonian genera. The tripartite infrabasal circlet is the customary intermediate stage between five *IBB* and an anchylosed ring. The central lumen of the column with peripheral canals occurs elsewhere among the Inadunata and, although interesting structurally, is of doubtful value in defining systematic units. In any event, we do not know the column of *Thyridocrinus*, and the fact that no signs of peripheral canals are shown on the *IBB* is inconclusive, to say the least. In my opinion, the species has no relationship to *Lecythiocrinus*, with which it agrees only in the possession of three infrabasal units and a lateral opening.

Apart from the immediate consideration of structure as applied to *Thyridocrinus* the struc-

ture of the posterior interradius of the Gasterocomidae has far wider implications. We have in effect in these forms an incipient anal tube. We find one or more of the proximal tube plates enlarging and becoming incorporated in the cup. In the case where a single tube plate hypertrophies and becomes fixed in the cup one has a structure that is certainly analogous to that in *Cyathocrinus* and its near allies. Personally, I believe the plates in the two cases to be homologous.

An examination of Schultze's (1866) figures of *Gasterocoma* or, of course even better, an examination of actual specimens will show a great variation in the supplementary plates of the posterior interradius. In the type species, *G. antiqua*, almost any specimen will show one or more plates attached to the *post B* or to the *RR* at the margins of the lateral opening. In better preserved specimens a complete ring of plates is shown, and in one specimen that I have examined the entire opening is covered. In this specimen there is a nipple-like protuberence composed of small plates. The tip is fractured, but evidently there is a small opening that is the anal opening proper. I suspect that a similar structure obtains in Schultze's (1866) plate 12, figure 1C, where both in the figure and in the explanation of the plate the small anal opening is given as piercing the posterior basal.

There is considerable variation in the size and arrangement of these covering plates. In *G. antiqua* the posterior basal seems most often to support two plates. Three plates are occasionally found, and in some specimens there is a single plate extending the full width of the distal face of the basal. The simple plate structure is well shown by Schultze (1866) in pl. 12, fig. 2, in another species, *G. mülleri*. Such a plate is, I believe, comparable to the single plate shown in *T. patulus*, and such a structure does not militate against the inclusion of *patulus* within the genus *Thyridocrinus*. As a matter of fact, *T. problematicus* may have had a similar plate, not so well developed nor so thoroughly incorporated in the cup.

Some years ago (1934, p. 6), in the description of the genus *Corynecrinus* and the establishment of the family Lecythocrinidae, I suggested that the anal tube of *Lecythocrinus* and *Corynecrinus* might well be derived from an incipient anal tube such as is shown in *Gasterocoma*. In these two genera and in *Cestocrinus* from the Mississippian subsequently described (1940) two subequal tube plates rest on *post B*. Whether an anal tube be short or long is of little consequence. The fundamental structures are there in any event. Now I would go even further. In the case of many crinoids with a single plate in the posterior interradius, such as *Cyathocrinus* proper, I think the weight of evidence is strongly in favor of considering it as originally a proximal tube plate. In describing the genus *Zygotocrinus* (1943, p. 644) I stated my belief that the so-called *RA* and *RT* of *Parisocrinus* were originally tube plates. I shall now add the *X* of *Parisocrinus* as having a like origin.

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ENTOMOLOGY.—*The genus* Ollarianus (*Homoptera: Cicadellidae*) *in North America, including Mexico.*[1] Dwight M. DeLong, Ohio State University. (Communicated by C. F. W. Muesebeck.)

The leafhopper genus *Ollarianus* was erected by Ball in 1936[2] to include several similar species from the Southwestern United States and *Eutettix balli* Van Duzee, a Jamaican species, which was designated as the genotype. The species of the genus are similar in color and general appearance. The vertex is short, broad, almost parallel-margined, and rounded to the front. Most species have four black spots in a row between the anterior margins of the eyes. The outer and inner pairs may differ in size in different species or be entirely wanting as in *strictus*. There may be a pair of round black spots on the outer portion of the pronotum and in some species a pair on the scutellum.

In order to identify the Mexican species, which resemble those from the southwestern United States in form and coloration, it was necessary to study the characters of the male genitalia. This study has revealed the fact that although the aedeagi may differ in form among the species of the genus, all have either one or two pairs of pygofer spines, the number, position, and type being definite for any species. Certain species exhibit decided affinities on the basis of genital structures. For instance, *strictus* and *bullatus* can be separated only by the longer ventral spines in the latter species, while *tripartitus* has an aedeagus quite similar to those of *strictus* and *bullatus*. The aedeagi of *ollus* and *vestigii* are almost exactly alike, but the apical spines are entirely different. The aedeagi of *lobatus, insignis, bidentatus,* and *armus* are similar in type, and each of these species has one pair of ventral pygofer spines. The aedeagus of *rudiculus*, as well as that of *muesebecki*, is unique in type as compared to all the other species.

It is unfortunate that *E. balli* was made the genotype as that species was described from a single specimen from Jamaica that had lost the abdomen. The genital characters for neither sex are therefore known. In spite of this fact, it has seemed advisable to determine and illustrate the specific characters of the other known species and to describe those that have distinct genital characters but that have not been previously treated.

According to present records only one species, *strictus*, is common to both the United States and Mexico. *O. rubianus* Ball is a member of the genus *Eutettix*, while *Exitianus armus* Ball is a member of *Ollarianus*. After studying all the species which have been placed in or assigned to the genus, and examining the genitalia, it seems advisable to include in the genus the described species *balli, bullatus, strictus, rudiculus, ollus,* and *armus* and to describe at this time six Mexican species, *muesebecki, tripartitus, insignis, bidentatus, lobatus,* and *vestigii*, which are new.

SEPARATION OF SPECIES ON THE BASIS OF GENITAL STRUCTURES

1. Pygofer with one pair of spines............2
   Pygofer with two pairs of spines...........3
2. Spines basodorsal, especially long...*bidentatus*
   Spines more ventral, much shorter.......... ....*armus, insignis, lobatus*
3. Ventral pair of spines especially short, inconspicuous...........................*strictus*
   Ventral spines longer, conspicuous.........4
4. Aedeagus erect, short, broadened toward apex, and appearing to have three apical processes ....*bullatus, tripartitus*
   Aedeagus longer, not broadened apically but usually with a pair of apical processes....5
5. Aedeagus with a dorsally curved, hooked process at apex of elongate, slender ventral portion 6
   Aedeagus not elongate and slender and without dorsally curved hooked apices...........7
6. Apical pygofer spines short, enlarged at apex, and set with pointed teeth...........*ollus*
   Apical pygofer spines long, slender, with a foot-shaped enlargement at apex....*vestigii*
7. Pygofer spines flat, broad at base, bladelike, aedeagus with a median dorsal projection.. ....*muesebecki*
   Pygofer spines not bladelike, broadened near apex to be spearlike, aedeagus elongate, broadened at middle, and constricted just before blunt apex...............*rudiculus*

Ollarianus balli (Van Duzee)

Eutettix balli Van Duzee, Bull. Buffalo Soc. Nat. Hist. **8**: 68. 1907.

[1] Received September 29, 1944.
[2] Bull. Brooklyn Ent. Soc. **31**: 59. 1936.

A small pale species with a transverse row of four black spots on anterior portion of vertex. Length 4 mm.

Vertex broadly rounded scarcely longer at middle than next the eyes.

Color pale testaceous-yellow, vertex with a transverse row of four black spots between the anterior margins of the eyes. The outer pair is on the ocelli, the median pair minute, the four are about equidistant in spacing. Pronotum with a round black spot behind each eye and a transverse spot on the disk. Scutellum with a pair of median brown spots. Face pale with a pair of minute spots on base. Elytra subhyaline marked with fuscous spots on clavus, disk, and apical areoles smoky.

Genitalia: Nothing is known of either male or female structures.

This species was described from a single specimen from Montego Bay, Jamaica, in 1907, the abdomen of which was missing. In order to determine the identity of this species, which has been made the genotype, it will be necessary to obtain a male from the same locality and determine the male structures by dissection. There is no question about its generic relationship to the other species included in the following pages.

Ollarianus armus (Ball), n. comb.

Exitianus armus Ball, Bull. Brooklyn Ent. Soc. **28**: 227. 1933.

Vertex broadly rounded, about one-third wider between eyes at base than length at middle. Length 3.7–4.5 mm.

Color pale yellowish, a large round black spot next each eye just above margin, a pair of proximal small transverse spots on middle between the larger spots. Pronotum with a large round black spot next each lateral margin behind eye, some smaller markings on disk. Scutellum pale with a black line along each side of apex. Elytra subhyaline, veins dark brown. Face pale with two minute spots on middle of face below margin.

Genitalia: Female last ventral segment slightly excavated each side of a broad median slightly produced lobe, which is embrowned on margin. Male plates triangular, narrowing to slender apices. Styles broad at base rapidly tapered to a pointed, outwardly curved apex. Aedeagus rather short and thick with a pair of rather long pointed apical processes which are directed ventrally. A dorsally produced portion arises at base. There is one pair of spines on pygofer and these arise ventrally at about the middle.

This species has been recorded for southern Arizona only, where it was taken from desert hackberry at Tucson and Superior by Dr. Ball.

Ollarianus strictus (Ball), n. comb.

Eutettix strictus Ball, Can. Ent. **32**: 204. 1900.
Chlorotettix minor DeLong, Ohio State Univ. Bull. **23**: 6. 1919. New synonym.

A yellowish species usually without definite markings. Length 3.5–4 mm.

Vertex broadly roundedly produced, almost twice as wide between eyes at base as median length.

Color yellowish, often washed with gray and usually unmarked. Face pale yellow. Sometimes the vertex has the four characteristic small spots of other species of the genus in a transverse row before the eyes and a pair of small round spots on disc of scutellum.

Genitalia: Female last ventral segment with posterior margin truncate, slightly produced at middle. Male plates broad at base, long, triangular with the acute apices produced and bright orange in color. The styles are rather broad to near apex where they are excavated on the outer margin to form rather pointed apices which are curved outwardly. Aedeagus short, broadened from base to form what appears to be in lateral view three distinct apical portions. In ventral view these appear as lateral protrusions. There are two pairs of spines on the pygofer, a long pair that arises from the dorsal median portion and extends ventrally and caudally. A smaller pair is short and arises on the ventral basal portion of the pygofer.

This species was described from specimens taken in Arizona and it has since been collected in Texas. Mexican specimens have been collected at Hermosillo, Sonora, November 29, 1927 (M. F. 1220); Cajeme, Mexico, November 19, 1935 (M. B. 384); Yaqui Valley, Sonora; Montemorelos, Nuevo León, June 3, 1930 (M. F. 2023); Los Mochis, Sinaloa, May 17, 1930 (M. B. 301); and Eloxochitlan, Oaxaca, June 27, 1932 (M. F. 2638), collected by Dr. Dampf. Specimens were also collected at Tehuantepec, Oaxaca, October 13, 1941, by Caldwell, Good, Plummer, and DeLong.

Ollarianus rudiculus Ball

Ollarianus rudiculus Ball, Journ. Washington Acad. Sci. **26**: 434. 1936.

A pale species with four round black dots in a row across anterior portion of vertex and a pair on scutellum. Length 5 mm.

Vertex broad, rounded, more than twice as wide between eyes at base as median length.

Color pale yellow, a row of four round black spots about equidistant from one another across vertex between anterior margins of eyes. The middle pair is a little posterior to the outer pair. Pronotum with a round black spot on anterior margin, either side just posterior to middle of eye. Scutellum, with a pair of small round proximal spots on disk. Face pale with portions of brownish arcs.

Genitalia: Female last ventral segment truncate, the median third roundedly produced. Male plates broad at base, narrowed, then produced into rather broad apices which are divergent, sloping to outer margin at apex. Styles long and slender, broadened at base but rapidly narrowed and produced to slender produced portions which are sharply pointed at apex. The aedeagus is broadened at middle then constricted before an apical headlike tip. On the dorsoanterior margin a slight enlarged process is formed just beyond the enlarged portion. Two pairs of spines occur on the pygofer. A long pair arises on the dorsal apical portion and extends ventrally. In caudal view they are broad, bladelike and are pointed at apex. A second pair arises ventrally at about the middle of the pygofer and extends inwardly and dorsally.

The specimens from which this species was described were all taken in southern Arizona. It has been collected in Texas by Prof. J. N. and Mrs. Dorothy Knull.

Ollarianus bullatus Ball

Ollarianus bullatus Ball, Journ. Washington Acad. Sci. **26**: 433. 1936.

A black-faced species with four spots across anterior portion of vertex or without vertex markings. Length 4 mm.

Vertex broad, blunt, scarcely twice as broad between eyes at base as median length.

Color, face black, appearing as a black, marginal line from above. The vertex may not bear color markings. In well-marked specimens with a row of four black spots across anterior portion of vertex between anterior margins of eyes. The central pair is larger so that in poorly marked specimens the central pair may persist when the outer pair is not visible. Elytra pale, veins inconspicuous.

Genitalia: Female last ventral segment with posterior margin truncate, with a broad, roundedly triangular median projection. Male plates broad at base, roundedly narrowed to long acute tips. Style rather broad, excavated on outer margin just before outwardly bent and pointed apices. Aedeagus very similar to *strictus* with a broadened apex which appears divided into three apical portions. Pygofer with two pairs of long spines. One pair arises dorsally and basally, and the other arises on the ventral median portion.

This species can be separated from *strictus* by the black face and the long ventral pygofer spines.

All specimens in the type series were from southern Arizona. The collections made by Professor and Mrs. Knull have shown that it occurs in Wickenburg, Patagonia, and the Santa Rita Mountains in Arizona, and in the Davis Mountains and Val Verde County in Texas.

Ollarianus ollus Ball

Ollarianus ollus Ball, Journ. Washington Acad. Sci. **26**: 433. 1936.

Resembling *rudiculus* in form and general appearance but with distinct male genitalia. Length 4–4.6 mm.

Vertex broad, rounded, almost parallel-margined.

Color pale yellow, with four faint black spots in a transverse row between the anterior margins of the eyes. These are sometimes wanting. Elytra slightly smoky in the males with the cross nervures emphasized.

Genitalia: Female last ventral segment with posterior margin nearly truncate, the median third roundedly produced. Male plates narrowed to elongate pointed apices. The concave portion of margins before the tips are heavily margined with black. Style rather broad to near apex where the outer margin is rather deeply excavated forming a narrow fingerlike apex, which is curved outwardly. Aedeagus composed of a ventral straight portion, which has a dorsally curved pointed hook at apex. At the base a dorsal portion is directed dorsally

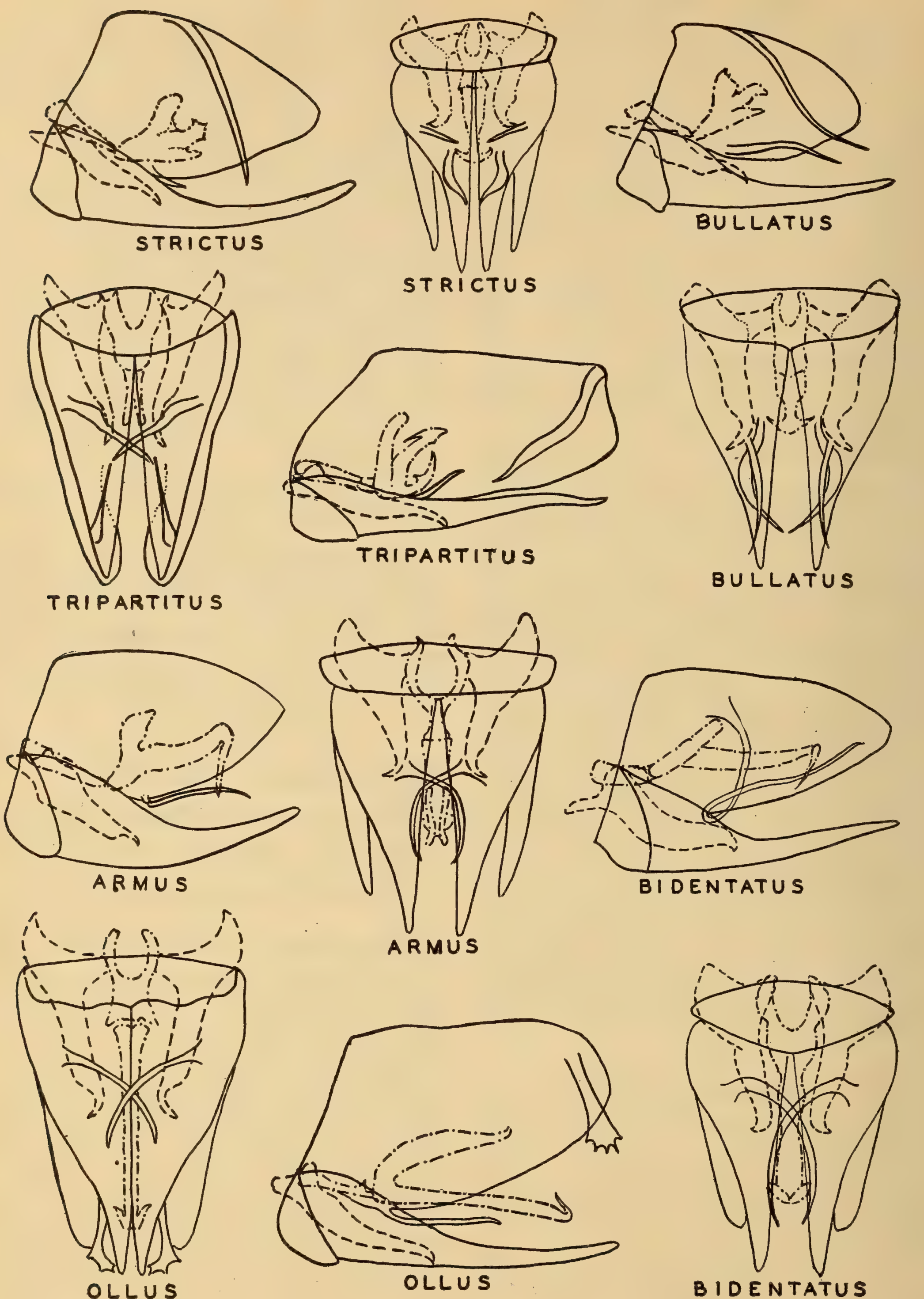


Fig. 1.—Leafhoppers of genus *Ollarianus* Ball: Ventral and lateral views of male genital structures of species as labeled.

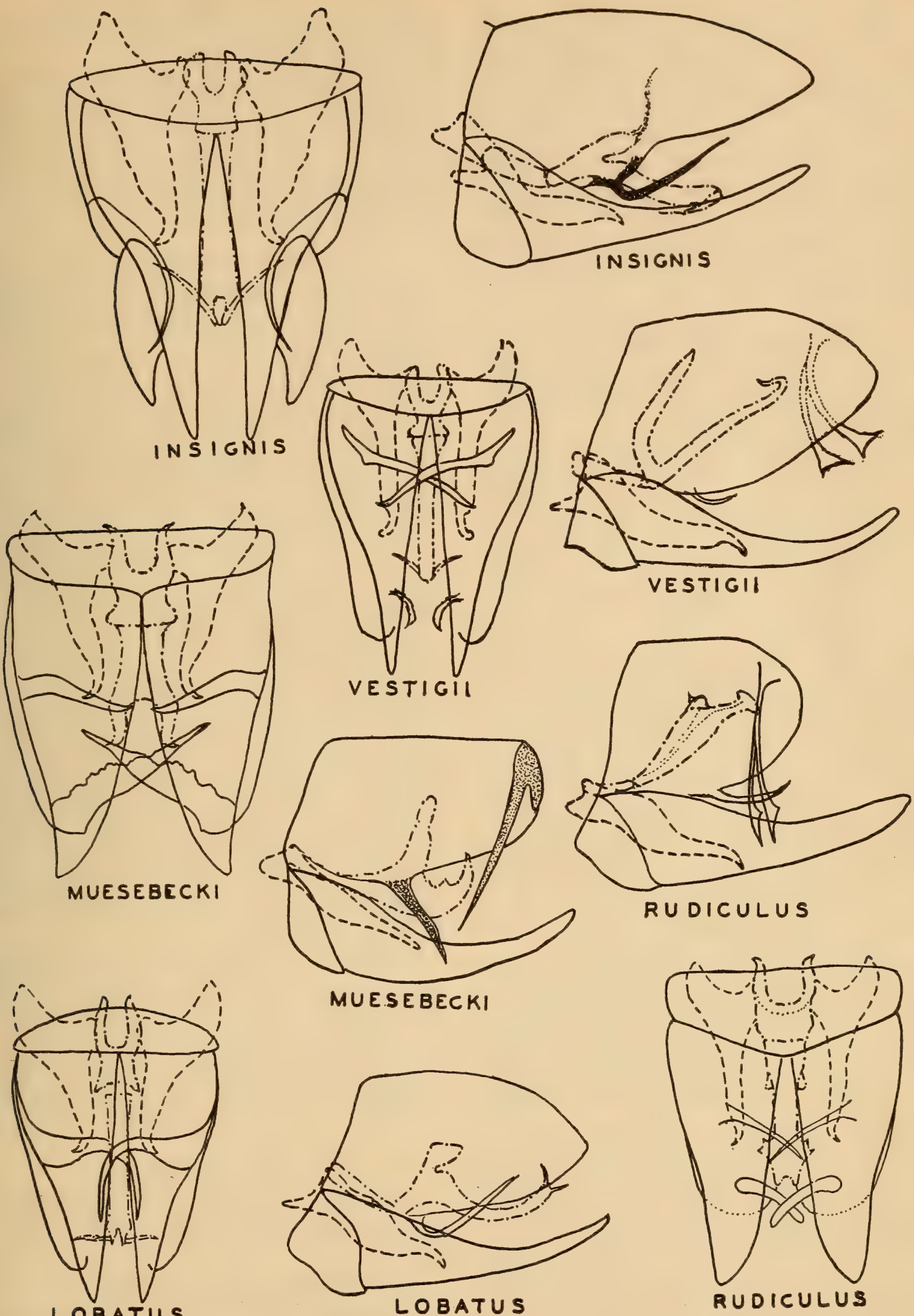


Fig. 2.—Leafhoppers of genus *Ollarianus* Ball: Ventral and lateral views of male genital structures of species as labeled.

and apically. It is shorter and a little broader than the ventral portion and is narrowed at the apex. There are two pairs of pygofer spines. The apical pair arises on the apical dorsal portion of the pygofer. These are rather short, enlarged at apex and bear several radially arranged apical pointed teeth. The ventral pair is long and slender, arises near the base of the pygofer, and extends inwardly and apically.

The specimens from which this species was described were taken in the Santa Rita Mountains of Arizona.

Ollarianus muesebecki, n. sp.

In general form, appearance, and coloration resembling *rudiculus* but with distinct male genitalia. Length 4.5 mm.

Vertex broadly rounded, more than twice as wide between eyes at base as median length.

Color yellowish, vertex with four round black spots about equidistant from each other in a row across vertex between anterior margins of eyes. Pronotum with a round black spot on anterior margin behind each eye. Pronotum appearing darker.

Genitalia: Female last ventral segment roundedly produced with a rounded notch or excavation each side of median third, giving the posterior margin a trilobate appearance. Male plates narrowed to bluntly pointed, outwardly curved apices. Style broad at base rather gradually but strongly tapered to acutely pointed outwardly curved apex. Aedeagus rather short and erect, the apex divided into two converging processes which are upturned. At about its middle a process extends dorsally which is rather long, thick, and blunt at apex. The apical spines arise on the dorsoapical portion of the pygofer and extend ventrally. These are flattened like broad blades in caudal view. The ventral spines arise at about the middle on the ventral side and extend inwardly.

Holotype male collected at Iguala, Guerrero, Mexico, September 11, 1939, and allotype female collected at Chilpancingo, Guerrero, Mexico, elevation 4,488 feet, September 10, 1939, by Plummer and DeLong. Paratype males from Iguala, Guerrero, elevation 2,398 feet, same date; Chilpancingo, Guerrero, October 25, 1941; Zamora, Michoacán, elevation 5,140 feet, October 2, 1941, all collected by Plummer, Good, Caldwell, and DeLong. A paratype from El Mante, Tamaulipas, elevation 264 feet, October 26, 1930, collected by Dr. Dampf (M. F. 1775).

I take pleasure in naming this species in honor of Dr. C. F. W. Muesebeck through whose kindness it has been possible to study the types of this genus in the U. S. National Museum and thus describe the Mexican species that have previously been unnamed.

Ollarianus tripartitus, n. sp.

Resembling *rudiculus* in form and general appearance but with distinct male genitalia. Length 4.5 mm.

Vertex broadly rounded, more than twice as wide between eyes at base as median length.

Color yellowish, vertex with a straight transverse row of four round black spots just before anterior margins of the eyes. The outer pair is much larger than the median pair. Pronotum with a round black spot behind each eye on anterior margin. A pair of round black proximal spots on disk of scutellum. Elytra subhyaline, veins pale brown. Face yellow.

Genitalia: Male plates long, gradually tapered to bluntly pointed apices. Style elongate, rather narrow, apical portion narrowed to a finger-like process which is curved slightly outwardly. Aedeagus short, erect, the basal and median processes are single, the apical-ventral portion is paired. Two pairs of spines are located on the pygofer. The apical pair arises on the apical dorsal portion and extends ventrally and anteriorly. The ventral pair arises at about the middle of the ventral margin and extends medially and apically.

Holotype male and paratype males collected at Iguala, Guerrero, Mexico, elevation 2,398 feet, September 11, 1939, and October 25, 1941. Paratype males from Mexcala, Guerrero, elevation 1,706 feet, December 13, 1929, collected by Dampf (M. F. 1513), and Veinco, Guerrero, September 3, 1940 (M. F. 1790).

Ollarianus insignis, n. sp.

Resembling *armus* in the intense color pattern but with distinct male genitalia. Length 5 mm.

Vertex broad, bluntly produced, less than twice as wide between eyes at base as median length.

Color gray, vertex with a transverse straight row of four black spots between anterior mar-

gins of eyes. The outer pair of spots is larger than the inner pair. Pronotum with brown mottling on disk, the humeral angle almost entirely covered by a large black spot. Scutellum pale with two black spots along outer margin on each side. Elytra marked with brown spots. Usually three pairs along commissure, a spot each side on disk and tips of elytra smoky. Face pale with two small proximal spots on upper portion.

Genitalia: Female last ventral segment with posterior margin sloping to median third, which is roundedly produced. Male plates long, strongly concavely narrowed to slender apices. Style gradually narrowed from base to form narrow apices, which are bent outwardly. Aedeagus rather short with a dorsal process at base. The main portion of aedeagus curved, extended apically with a pair of rather long apical spines extending ventrally and laterally. A pair of pygofer spines arises ventrally at about the middle and curves apically.

Holotype male collected at Puente de Ixtla, Morelos, December 27, 1929 by Dampf (M. F. 1557). Allotype, female, collected at Zamora, Michoacán, elevation 5,140 feet, October 2, 1941. Paratype males and females collected at Acapulco, Guerrero, elevation 328 feet, October 24, 1941; Chilpancingo, Guerrero, elevation 4,488 feet, October 25, 1941; Jiutepec, Morelos, elevation 3,500 feet, September 6, 1939; Iguala, Guerrero, elevation 2,398 feet, October 22, 1941; Zamora, Michoacán, elevation 5,140 feet, October 2, 1941; Tehuantepec, Oaxaca, elevation 328 feet, October 13, 1941; Mexcala, Guerrero, elevation 1,706 feet, October 22, 1941; Guadalajara, Jalisco, elevation 5,051 feet, October 3, 1941; Puente de Ixtla, Morelos, December 27, 1929; Pungarabato, Guerrero, August 22, 1930 (M. F. 1769); Zincauro, Guerrero, September 2, 1930 (M. F. 1789); and Paxtial, Guatemala, elevation 660 feet, September 14, 1925 (M. F. 807).

Ollarianus bidentatus, n. sp.

Resembling *ollus* in general form and appearance but with distinct genitalia. Length 4–4.5 mm.

Vertex broad and blunt, almost parallel-margined, about twice as wide between eyes at base as median length.

Color yellow with the usual row of four black spots between the anterior margins of the eyes. The outer pair is large and rounded, the inner pair minute. Scutellum with a small spot on either side not far from apex.

Genitalia: Female last ventral segment with posterior margin truncate, median third roundedly produced. Male plates long, strongly concavely rounded on outer margins to form long slender apices. Style broad at base, narrowed rather abruptly before middle, the apex pointed and bent outwardly. Aedeagus with a short dorsally directed process at base. The main portion of aedeagus elongate, narrowed toward apex with a pair of rather long slender pointed apical spines directed ventrally. One pair of pygofer spines arises on the dorsal portion near the middle. These are long and slender, extending ventrally and medially, then curving apically and extending almost to apices of the plates.

Holotype male, allotype female, and male paratypes collected at Iguala, Guerrero, elevation 2,398 feet, October 25, 1941, and September 11, 1939, by Plummer, Good, and DeLong. Paratype males collected at Balsas, Guerrero, August 15, 1930 (M. F. 1754); Zirandaro, Guerrero, elevation 639 feet, August 29, 1930 (M. F. 1786); San Geronimo, Guerrero, August 30, 1930 (M. F. 1787); Coyuca-Catalon, Guerrero, August 24, 1930 (M. F. 1771) by J. Parra; male paratypes were also collected at Jiutepec, Morelos, elevation 2,500 feet, September 6, 1939, and Valles, San Luis Potosí, elevation 312 feet, September 24, 1941, by Plummer, Good, Caldwell, and DeLong.

Ollarianus lobatus, n. sp.

Resembling *bidentatus* in form and appearance but with vertex more produced and with distinct genitalia. Length of male 5 mm.

Vertex broadly rounded and bluntly produced, basal width about twice median length. A little longer at middle than next the eyes.

Color yellow with a transverse row of four black spots on vertex between anterior margins of the eyes. The outer pair is rounded and larger. The inner pair is minute. Elytra subhyaline without conspicuous veins, face with traces of pale arcs.

Genitalia: Male plates rather long, concavely rounded on apical half to form pointed apices. Style broad at base rapidly narrowed to narrow, pointed outwardly bent apices. Aedeagus with a dorsally extended lobate structure at

base. The main portion is curved, directed apically and bears a pair of rather long laterally directed spines at apex. Pygofers with a pair of ventral spines arising not far from base which extend inwardly and curve apically.

Holotype male collected at San Geronimo, Guerrero, August 30, 1930, by J. Parra (M. F. 1787).

Ollarianus vestigii, n. sp.

Resembling *strictus* in general form and appearance but with distinct male genitalia. Length 4–4.5 mm.

Vertex broad, bluntly produced, more than twice as broad at base as median length.

Color, vertex yellow with faint traces of the four black spots on anterior portion between eyes. The median pair is most easily recognized. Pronotum dull gray. Scutellum with a transverse row of minute round spots across disc. Elytra subhyaline with dark brown veins especially the apical cross veins, which are conspicuous. Three pairs of brown spots along commissure on clavus and small brown spots on base, corium, and posterior clavus. Apical portion smoky.

Genitalia: Female last ventral segment with posterior margin truncate, median third rather broadly, roundedly produced with a brown mark at middle and one either side of produced portion. Male plates elongate, triangular, tapered to acute, pointed apices. Style long, narrowed near base, apical portion excavated on outer margin and curved outwardly. Aedeagus composed of a long slender ventral portion which is curved dorsally and bears a hook at apex. A shorter but slightly thicker portion arises at base and curves dorsally. The pair of apical pygofer spines is elongate, slender, and broadened to form a footlike apex. The ventral pair arises basally, is rather long, and extends inwardly.

Holotype male, allotype female, and female paratype collected at Palomas, San Luis Potosí, October 12, 1931, by Dr. Alfonse Dampf (M. B. 338).

This species can be separated from *ollus* to which it is apparently closely related by the longer apical spines, which are broadened at the apex to form a footlike structure, and the absence of the ventral pygofer spines.

ENTOMOLOGY.—*Studies on flower flies (Syrphidae) in the Vienna Museum of Natural History.*[1] F. M. HULL. University of Mississippi. (Communicated by ALAN STONE.)

This paper presents the final study of some syrphid flies from a small collection submitted to the author in 1936 through the courtesy of Dr. Hans Czerny, whom I wish to thank for the opportunity of studying them. Other short articles have described species from this material from time to time. The types of the flies here described were deposited in the Naturhistorischer Museum in Vienna in 1938.

Genus **Baccha** Fabricius

Baccha ariela, n. sp.

This species is readily recognized by the large, central, irregular triangle of brown upon the middle of the wing, which connects broadly with the complete, anterior border of brown. Related to *clarapex* Wiedemann.

Female.—Length 11 mm; wing 10 mm. *Head:* hemispherical. The vertex and front are dark, shining brown, obscured by mold, probably violaceous in life. The large, shield-shaped, light-brown area before the antennae contains a small shining black spot. The antennae are widely separated and short. The third segment is thick and rounded. The face is rather prominent; the very large tubercle juts barely farther than the antennal prominence. The antennae are dark brown. The arista is short and thickened and black. The face is light reddish brown or yellow. The tubercle is dark brown and diffuse. From the lower part of the tubercle, along the oral margins of each side, there is a narrow blackish stripe running to the black cheeks. The cheeks posteriorly and along the oral margin are dark brown. The extreme lower occiput along the oral margin is light brown. The eyes are strongly excised just above the middle, silver-pubescent and scalose-pilose. The occiput behind is quite concave, so that the head fits well over the thorax and is very much wider than the thorax. *Thorax:* the dorsum is dully shining black with a strong

[1] Received July 31, 1944

violet cast. The sides, in a stripe almost as wide as the humeri and uninterrupted at the suture, are light ochre-brown. The pleura are entirely light yellowish brown. The humeri apparently are bare, but with some very short pubescence. The scutellum is entirely light coffee-brown, dully shining. There is no scutellar fringe, but it may have been rubbed away. *Abdomen:* strongly spatulate; the sides of the fourth segment are parallel and three times as wide as the middle of the second segment. The end of the second segment is one and two-thirds or one and three-fifths as wide as the middle. The extreme base of the abdomen is twice as wide as the narrow part of the second segment. The base of the second segment is little wider than the narrowest part. The end of the fifth segment is two-thirds as wide as the base of that segment; sixth segment small. Abdomen obscured by mold; it appears to be dark reddish brown, with obscure yellow spots that are palest on the fourth segment, and triangular in shape in the anterior basal corners. There are very dark opaque brown cross bands present; these are rather wide and begin on the posterior, lateral margin and are directed obliquely toward the anterior middle of the segment and meet very broadly in the middle. This is the arrangement on third and fourth segments. The second segment in the middle has a large, opaque, cone-shaped spot of the same color as the cross band. The pile of the abdomen is quite appressed and black. The halteres are pale orange. The squamae are whitish with yellow margins. *Legs:* the first and second femora and tibiae are light orange-brown or yellow, paler at the apices and bases of femora and tibiae, respectively. All the tarsi are dark brownish black. The bases of the hind tibiae are pale yellow. *Wings:* hyaline, except for extensive brown patterns. There is no stigmal cross vein; the vena spuria is faint; wings villose. The alulae are well developed. The entire anterior margin of the wing above the third vein is dark brown; this brown color descends basally to fill the first and second basal cells or slightly below them, to fill the basal anterior corner of the first posterior cell, nearly the basal half of the discal cell, and the basal half of the posterior to the discal cell.

Holotype.—A female, from Brazil (collection of Winthem).

This species was figured in the review of *Baccha* by the author, in Entomologica Americana **23**: 89, fig. 49. 1943.

Genus **Microdon** Meigen

Microdon (Omegasyrphus) biluminifera, n. sp.

Characterized by the slender form and the large hyaline spots at the base of the brownish abdomen. Related to such species as *baliopterus* Loew.

Male.—Length 12 mm exclusive of antennae; wings 10.2 mm. Antennae 2.5 mm. *Head:* short, much wider than the thorax. The ocelli are raised into a very conspicuous, round, subglobose, vertical dome, in front of which is a marked crease. The front, beginning at this crease, is rather short and barely longer than the second antennal segment. The antennae are thus set high upon the head; they are elongate. The second segment is barely longer than wide, the third segment nearly five times as long as the second and the first segment about as long as third, or barely longer. The third segment is subtruncate and flattened at tip, widened in the middle, with a lateral crease and with a deeply thickened arista, which is only two-thirds the length of the segment. First two segments dark brown, third lighter. The vertex and the front and upper part of the face are very dark shining brown, the lower part of the face and cheeks light shining brown. There is a thick band of silvery-yellow pile on the lower sides of the face which is continued narrowly up the sides of the face, not quite to the level of the antennae. There is a bare shield-shaped spot above the antennae. The eyes are bare. *Thorax:* very dark brown and covered with an appressed, setaceous-black pile; and on the suture there is a band of flattened, pale, brassy pile and similar flattened pile in the posterior part of the midline, which is directed posteriorly and meets a broad, semicircular area of similar pile lying just in front of the scutellum and which is directed forward so as to intermesh with this. The scutellum is light brown, shining, roughly triangular on its posterior margin and terminates in two tiny, very close-set points. Humeri pilose. The pleura have a row of pale, sericeous, stiffened hairs. The metanotum is conspicuous and large. The halteres are orange, the squamae pale brown. *Abdomen:* rather elongate, a little wider than the thorax; nearly four times as long as wide. The sides of the last two segments are nearly

parallel but practically cylindrical; they are barely wider at the base of the third segment. The second segment is only a trifle wider in the middle than the third segment but is much flattened, especially over an area corresponding to the spots, which are actually concave. The lateral, ropelike margin on the second segment is thick and prominent. The first segment is rather short, with a deep crease between it and the second segment. The second segment is neither cylindrical nor flat; it is rather inflated and marked on each side with a large, posteriorly pointed, anteriorly broad, quite hyaline spot, which is continuous on the sides with the translucent yellow margins and which is divided in the middle by a roughly triangular, black spot; its base lies on the posterior margin of the segment, its peak is narrowly continuous with the first segment. The remainder of the abdomen is very dark brown and densely appressed-setate with crevices for the setae; on the posterior margin of the third segment, not reaching the sides, there is a band of flat, golden, posteriolaterally directed pile, which is widely separated in the middle. A similar band on the fourth segment is equally separated, beginning about the middle of the segment, and obliquely directed away toward the posterior corners, after first being directed toward the midline. The hypopygium is perfectly rounded. *Legs:* light orange-brown, becoming almost golden yellow on the tibiae and tarsi. The hind femora are a little thickened, especially on the scar a third of the way from their bases. The thickening gradually extends throughout the remainder of each femur. There are no ventral spines. The last half of each of the hind tibiae is rather thick, ending simply, with an oblique scar in the middle. *Wings:* considerably longer than the abdomen, very pale brown and thickly pilose. The spurious vein is chitinized, the posterior veins are brown; the anterior veins yellow, the stigmal cell pale yellow, the costal cell and the small area past it also yellow.

Holotype.—A male, from Espirito Santo, Brazil (collection of Fruhstorfer).

Microdon (Omegasyrphus) baliopterus Loew **brunnipennis,** n. var.

Male.—Length 9.5 mm without antennae; wing 7.2 mm. *Head:* hemispherical and a little wider than the thorax. The vertex is swollen, convex, and purplish coppery; the sides of the face are parallel. The face is quite convex, slightly violaceous, and narrower than in *baliopterus* Loew. The first segment of the antennae is light brown and about four times as long as wide; the second segment is light brown and about a fourth as long as first segment; third segment missing. *Thorax:* dark shining black with very obscure violaceous vittae. The scutellum is shining, with a violaceous cast and two small points upon the rim, which are much shorter and somewhat farther apart than in *baliopterus. Abdomen:* of the same type of coloration as in *baliopterus* but without any black upon the sides of the third and fourth segments. *Legs:* entirely light brownish red and but little darker on the femur; the basal scar is much less prominent than in *baliopterus.* The halteres are almost white instead of deep orange-brown. The squamae are white, but are yellow to orange in *baliopterus. Wings:* the pattern of the infuscation of the wings is similar to that of *baliopterus*, but the bulge in the lower vein seems to be less conspicuous. The dark markings seem to be more uniform and less diffuse in the centers of the cells.

Holotype.—A male, from St. Thomas, Guatemala (Alte Sammlung).

Originally, I held this fly to be distinct from *baliopterus;* I now believe it better considered a variety for the present; the species of *Microdon* seldom have a large range, and this must be considered quite an extension of the range of *baliopterus.*

Genus **Merodonoides** Curran

Merodonoides czernyi, n. sp.

Related to *circularis* Curran, this species is distinguished by the chiefly reddish femur and a different pattern of eye stripes.

Male.—Length 11.5 mm; wing 6.5 mm. *Head:* large and somewhat broader than the abdomen. The eyes are bare and red-brown, with four vertical stripes; the posterior stripe lies on the margin of the eye, is smooth-edged and continuous; the other three are equally spaced but quite irregular and become very slender and disappear ventrally and are partly broken up into spots. The vertex is dark brown, the upper front black and covered with light yellowish-brown pubescence; the eyes are barely approximated, not actually touching; the lower front, except from the narrow, shin-

ing black rim to the antennal prominence, is shining black and densely covered with yellowish pubescence. The face below the antennae is covered everywhere, except from the facial knob and a narrow continuation of the knob to the epistoma, with pale pubescence and thick, rather long, shiny, yellowish pile; this pile and pubescence are omitted on the extreme lower face and cheeks. The antennae are fairly large. The third segment is a little over one and one-half times as long as wide; it is rounded apically and is pale orange and has narrow, dark, dorsal margins; the first two segments are slightly darker. The arista is basally thickened, barely longer than the antenna, and pale orange. *Thorax:* the ground color is feebly shining and very dark brown; on the mesonotum are four wide, black vittae; the outer pair is not interrupted at the suture, the inner pair is slightly closer than the separation between outer and inner stripes. The stripes do not reach the scutellum. The scutellum is large, broad, two and one-half times as wide as long, with subtruncate rim and feebly impressed rim; its color is light reddish brown. The pile of the thorax, scutellum, and humeri is light yellowish, becoming golden on the scutellum. *Abdomen:* not quite twice as long as wide, rather thick; the terminal segments are cylindrical, with a large hypopygium. The base of the fourth segment is three-fifths as wide as the widest part of the second segment close to the base. From near the base of the second segment the abdomen tapers gradually down to the end of the third segment. The first segment is gray; the second segment has a narrow but conspicuous black basal border and just before the apex a wider, dark brown band that is produced obtusely forward in the middle and not quite touching the anterior black band, and instead of brown in the middle of this band there is an oblong, elongate black spot. The remainder of segment is light brownish yellow. The third segment is similar in color without any black band and with the posterior brown band vague in form and in outline. The entire basal three-fifths of the fourth segment, except for narrow, small triangles in the lateral corner at the base, is dark brown; the remainder is light yellow. The pile of the abdomen is pale yellow to reddish brown according to the area. *Legs:* almost entirely light reddish brown, with an irregular black band in the middle of each of the thick hind femora which disappears toward the top half of the femora. On the inside of each of the front femora there is a small, basal, black spot; the apical portion of each of the front femora and all the front and middle tibiae and the extreme base of the hind tibiae are light yellow. The tarsi are light reddish. The apical spines of the femoral and basal patch of setae are black; otherwise the pile is pale. *Wings:* short and broad, the veins outlined in dark brown; remainder of the wings pale brown; a stigmal cross vein is present and beyond it a brown stigma, which is a little longer than wide. The spurious vein is chitinized. The wings apparently lack villi.

Holotype.—A male, from Tonkin, Montes Mauson, April–May, 2,000–3,000 feet (H. Fruhstorfer).

Genus **Mallota** Meigen

Mallota brevipila, n. sp.

This fly is characterized by its pale pink or reddish color on the abdomen, its whitish pile, and the slender black fascia on the abdomen. Apparently it is not closely related to other described species of *Mallota.*

Male.—Length 11 mm. *Head:* eyes bare, the vertex dark brownish black with yellowish-gray pollen and pale yellowish-white pile. The front is similarly colored; the pollen is yellower and somewhat sparser in the middle, particularly in front of the antennae; the dark-brown ground color of the front is thus allowed to shine through. The front is narrowly yellowish brown just in front of the antennae; the pile of the front and face is yellowish white. The eyes are rather widely separated in the male but are angularly produced toward each other. The width between them is as great as the distance between the posterior ocelli. The face is dark brown, thickly covered with yellowish-white pubescence, which is a little thinner on top of the well-developed tubercle and appears to have been rubbed off. The face is deeply concave beneath the antennae, and the cheeks are dark shining brown and largely bare. The antennae are dark brown. The third segment is wider than long, the first two segments equal. The arista is light yellow and thickened throughout its length; the apex, however, is sharpened. *Thorax:* brownish black and thickly covered with light brownish-gray pollen and thick but short, almost white pile. There is

a thin band of brownish-black pile across the middle between the wings. The pile of the postcalli, of the scutellum, and of the mesonotum in front of the scutellum is entirely whitish. The pleural pile is abundant and white. The squamae and their border and fringe are yellowish white. *Abdomen:* the first and second segments are almost entirely light red, becoming orange upon the lateral margins. The posterior border of the first segment exclusive of the posterior corners is, however, gray with yellowish-white pubescence. On the posterior part of the second segment near the posterior margin there is a somewhat darker brown, narrower fascia, which fades into light red as it approaches the lateral margin; the posterior margin is narrowly yellowish white with similarly colored pubescence and pile; the pile of both of these two segments is entirely white and becomes slightly more yellowish in the middle of the second segment. The third segment is light red; its posterior and anterior margins are narrowly yellowish white and pollinose, and on each side of these fasciae there is a slender, transverse fascia of black; the black fascia laterally fades into red on each side at a considerable distance from the lateral margin. Between the black fascia the segment is red. The fourth segment is dully shining black; upon it there is a trace of a basal, lateral, linear, yellowish-white pubescent fascia on each side of the segment. Lying within this black area on each side there is also a trace of a red, diffuse obscure fascia, which continues laterally into the reddish lateral margin. The posterior margin is broadly yellowish-white-pollinose. The hypopygium is shining black and white-pilose. The pile of the third and fourth segments is black on the posterior black areas and yellowish in front of the black areas and white elsewhere. The pile of the abdomen is much shorter than is characteristic for the genus *Mallota* and is rather short and setaceous and subappressed posteriorly on the second to the fourth segments. *Legs:* the first four femora are dark brown; their tibiae are brownish black in each case upon the apical half and yellowish brown basally. The tarsi are light brown. The hind femora are moderately thickened and are light orange-brown upon the lateral surface for the basal two-thirds and upon the dorsal surface for the basal two-fifths; elsewhere, except at its extreme apex, it is brownish black; its pile is long, abundant, and whitish, except for a ventral patch of black, appressed setae near the apex and except for a thick patch of longer, erect, black bristles ventrally near the base and a little more toward the medial surface. The hind tibiae are brown, and darker brown laterally upon each apical third. The tarsi are dark brown. *Wings:* nearly hyaline, the marginal cell widely open.

Holotype.—A male. One paratype male. Both from Turkmenien. Paratype in author's collection.

Mallota apimima, n. sp.

This species is related to *salti* Curran but is distinguished by the wholly black legs, and it is separated from *colombii* Macquart by the yellow pilose abdomen.

Male.—Length 15 mm. *Head:* the eyes touch quite narrowly at a point on the upper part of the head leaving the vertical triangle less than half as long as the front. The eyes are thick white-pilose and the vertex is feebly shining black with thick, long, black pile. The front is polished, shining black with sparse, long, yellow pile on the sides and a few long, black hairs at the top and through the middle. The face and cheeks are shing black with sparse, long, pale, pale yellowish pile that becomes dark brown to black in front of the cheeks. The anterior part of the cheeks and adjacent posterior part of face covered with a broad band of sparse white pubescence, which runs from the eye margin to the epistoma. The face is thus left broadly bare; the concavity below the antennae is rather deep, the tubercle low and broad. The first two segments of the antennae are black and black-pilose; the third segment is very dark reddish brown, obliquely oval, and a little longer below. The arista is pale yellow, thickened on the basal half. *Thorax:* mesonotum opaque black covered by dense brownish-black pollen. Across the mesonotum in front of the suture there is a band of dense, deep, yellow pile, which on the two sides is continued on to the humeri and the upper part of the mesopleura. Most of the mesopleural and all the pteropleural pile is brownish black. The pile on the posterior half of the mesonotum behind the suture and on the postcalli is blackish, the hairs apically becoming brown. There are just a few long yellow hairs immediately in front of the scutellum. Scutellum opaque reddish, or

sepia-brown with very long and very dense brownish-yellow pile. *Abdomen:* black, opaque upon the first two segments and shining black upon the remainder of the abdomen. The pile of the abdomen is thick, long, subappressed and brownish yellow on the whole of the second and third segments, except that there is considerable purplish-brown to blackish pile in the basal corners of the second segment and narrowly upon the sides of the first and second segments. The pile of the fourth segment is long, quite sparse, and light yellow. *Legs:* black and largely shining with black pile that becomes dark purplish brown upon the femora. The hind femora are only moderately thickened, the greater part of the thickening being found on the basal two-thirds. *Wings:* strongly tinged with brown; the interiors of the cells are more pale centrally, but there is a large, extensive, diffuse, brown blotch in the center of the wing. The apical half of the first basal cell has a diffuse, longitudinal, nearly hyaline bar down its middle, and there is a similar bar down the middle of the basal half of this cell.

Holotype.—A male, and one paratype male, from Venezuela. Paratype in author's collection.

Genus **Cerioides** Rondani

Cerioides rubrobrunnea, n. sp.

This species is related to *kerteszi* Shannon, from which it is distinguished by the reddish antennal prominence, and reddish third antennal segment, besides differences in the pattern of the wing.

Female.—Length 19 mm; antennae 5 mm; wing 14 mm. *Head:* the vertex is rather swollen; the ocelli are tuberculate; the occiput is not greatly produced behind the eyes near the vertex. There is a strong sunken depression just before the ocelli, and sublunate areas of opaque black lie at the top of the front along the eyes. The vertex and the front and upper face, except about the antennal process, are shining black with a slight bluish cast. The whole lower half of the face, from above the lower level of the eyes, as well as the cheeks and lower occiput, the antennal process, the third antennal segment, and a spot below the process are all light reddish or coffee-brown. The first and second antennal segments are dark brown to blackish. The apical half of the style is white. The antennae are elongate; the process is long, nearly as long as the slender first segment. The second segment is three-fifths the length of first and third segments; without the style it is a little longer than the second. The style is two-fifths as long as the second segment. On the black area of the face there is one pair of roundish spots of thick silver pubescence, and there is another pair a short distance farther down on the sides by the eyes. The face has a small rounded tubercle well below the eyes, and the face is deeply produced and slightly pointed at the apex of the epistoma. *Thorax:* unusually convex from any angle; it is entirely shining, slightly bluish black with, in certain light only, an overlay of vague, silver pubescence, and a vague, small, brown spot of the same lying longitudinally on the posterior half of the thorax in the middle. The thorax is quite scrobiculate. The scutellum is broad, short, rounded, and the basal margin and apical margin are light clay brown; its middle is bluish black, the surface scrobiculate. The metanotum is well developed and very steep. The halteres are pale yellow, humeri very prominent and convex; squamae white, brown-fringed. The pleura are entirely black, silvery pubescent in places. *Abdomen:* very strongly constricted basally; the apex of the second segment is barely wider than the base of the first; the second segment is only a little more than two-thirds longer than the first segment. The base of the second segment has a conspicuous, translucent, pale-brown band, which is narrowly interrupted in the middle. The second segment at its narrowest width is scarcely more than a third as wide as the posterior part of this segment. It is a little less than half as wide as the base of the first segment. Between the end of the second segment and the beginning of the third segment is a crease and a constriction, and the second segment expands suddenly and gradually into a beautifully rounded semicylindrical body, which reaches its maximum at the end of that segment and then tapers off into the long, slender fourth segment, which is one-half longer than the third segment and which, at its tip, is only half as wide as the end of the second segment. The fifth segment is drawn out into a blunt point. The entire remainder of the abdomen, the yellow basal annulus excluded, is dull shining black, with a very faint bluish cast and a heavily scrobiculate surface. *Legs:*

hind legs entirely dark brown, the basal half of the fore and middle femora deep reddish brown, the fore and middle tarsi light orange-brown; elsewhere the legs are dark brown. *Wings:* quite elongate and pointed; longer than the abdomen with the anterior border of the wing past the middle light orange-brown. The posterior basal half of the wing is of the same color. The posterior, apical half of the wing is quite pale brown, nearly hyaline and has a strong, rich, dark brown stripe running from the base of the wing to the apex; it includes the costal cell, the two cells beneath, and the entire upper half of the cell containing the spurious vein; it is delimited by this vein and by the upper outward half of the cell above.

Holotype.—A female, from Muzo, Colombia, 400–800 meters (collection of Fassl).

Cerioides polistiformis, n. sp.

This species is related to *facialis* Kertesz, from which it is distinguished by the yellow posterior fasciae on several of the segments of the abdomen and by the pattern of the face and wing.

Female.—Length 15 mm; antennae 4.5 mm; wings 14 mm. *Head:* the vertex is slightly raised and considerably developed behind the eyes; it is dark, dull shining black. The upper front has two sublunate impressions. The antennal prominence or process is two-fifths as long as the first segment. The front and face and cheeks are everywhere shining black, except that beginning a short distance beneath the antennal process there is a pair of rather slender, light yellow, vertical stripes, which are a little wider apart at the top than they are at the tubercle, and they continue to converge toward the epistoma but do not meet. The antennae are very elongate; the process and first two segments quite black, somewhat shining and deep black, flat-appressed-pilose. The base of the third segment is deep, rich red. The remainder of this segment is grayish brown, only the extreme tip of style white. The face has a rather prominent knob, though it is scarcely tuberculate, which lies below the eyes. The face is rounded, pointed, and considerably produced downward. *Thorax:* dull, shining black with papillose pile, which is exceedingly short. The black of the thorax is overlaid with very dark reddish-brown pollen, quite obscure and a little more evident where it forms a wide median vittae; in some lights the pollen appears to cover all the dorsum, leaving the sutures and a short abbreviated stripe at the inner ends of the sutures outlined in black. The scutellum is black and shining, with a narrow, brownish-yellow margin, scarcely visible above. The metanotum is conspicuous. *Abdomen:* elongate and pointed at the tip; the second segment is quite conspicuous, the end of the second segment is a little wider than the base of the first, and the base of the second segment is a very little wider than the narrowest part of this segment. The second segment is very little longer than the third segment. Third and fourth segments equal. Fifth segment small and pointed. The narrow lateral margin of the anterior half of the second segment and a conspicuous though fairly narrow, posterior margin on the second segment which is widest in the middle and upon the sides, and together with a similar slightly wider, uniform band upon the posterior margin of the third and fourth segments, are all yellow. Upon the third and fourth segments there are middle bands of yellowish-gray pollen, punctate and well interrupted in the middle, and on the fourth segment these bands are sublunate, their inner ends pointed, and the concave surface directed anteriorly. *Legs:* largely dark brown. The lateral surface of each of the fore-femora, the ventral surface of the midfemora, all the hind femora, the hind tibiae except their apices, the midtibiae except their apices, and the foretibiae except their bases are all very dark brown. The remainder of the legs are light orange-brown. The ventral spines of the rather slender hind femora are double-rowed, run the entire length, are rather long, sparse, black, and exceedingly sharp. *Wings:* the anterior margin of the wing above the third vein is brown, and the third vein is narrowly margined with brown posteriorly; also the upper half of the first basal cell is brown. The brown of the submarginal cell, and of the distal portion of the stigmal area of the subcostal cell, is considerably darker in color. The third vein emits a downward, oblique spur vein, and at the point of emission it is angularly but shallowly kinked; third vein and subapical cross vein confluent practically at wing apex.

Holotype.—A female, from Cuesta de Cillutincara, Bolivia, 3,000 meters (collection of Fassl).

ENTOMOLOGY.—*South African bees of the genera* Scrapter *and* Notomelitta (Hymenoptera).[1] T. D. A. Cockerell, Boulder, Colo. (Communicated by C. F. W. Muesebeck.)

The types of the new species described herein will all be placed in the British Museum, from which they were received.

Genus **Scrapter** Lepeletier and Serville

Scrapter braunsianus Friese and **S. leonis** Cockerell

Turner's No. 16, represented by 30 females and 5 males from Worcester, C. P., Lion's Head, Cape Town, and (1 female) Rapenburg, Cape Flats, is a mixture of three different things. The Rapenburg species has light red hair at end of abdomen, and mainly red tarsi, so it is quite distinct from the others. Sixteen females from Worcester agree with *S. braunsianus*, while 13 females and 5 males from Lion's Head are conspicuously smaller and must be referred to *S. leonis* Cockerell, although the recurrent nervures are in most specimens nearly equally distant from the ends of the second submarginal cell. It is now questionable whether *S. leonis* is really distinct from *S. capensis* (Friese), but the latter was based on a male, 10 mm long, from Little Namaqualand, and the males of the Turner species are all much smaller. Hence it appears certain that the original *S. capensis* is a different species, though *S. leonis* may later have been confused with it.

Scrapter subincertus, n. sp.

Female.—Length about 8 mm; shining black, the abdomen without bands; head broad, face and front with long white hair, not hiding the surface of the face; mandibles very faintly brownish; flagellum brown beneath except at base; clypeus coarsely punctured, with a deep median groove on upper half; supraclypeal area brilliantly polished; thorax with thin, pale hair, scanty above, except behind scutellum, where it is slightly reddish; mesonotum coarsely punctured, shining between the punctures; scutellum polished; area of metathorax rugulose and dull; tegulae very dark brown; wings dusky hyaline; stigma red, nervures brown; basal nervure falling a moderate distance short of nervulus; second submarginal cell long (much longer than in supposed female of *S. niger* Lepeletier and Serville), receiving first recurrent nervure some distance from base, the second more distant, but not twice as distant, from end (in *S. pallidipennis* Cockerell the first recurrent is nearer the base); legs black, with the tarsi reddish, and the anterior tibiae red in front; scopa of hind legs all pale; hair at end of abdomen pale, slightly reddish.

Cape Province: Rapenburg, Cape Flats, October 1–14, 1920. (R. E. Turner, 16 in part.) I was puzzled to know whether this could be the female of *S. niger*, but what I have identified as probably *S. niger*, from Natal, is certainly different. *S. niger* was described from Caffraria. The darker nervures, the absence of the dusky cloud beyond the cells, the details of the venation, and the dark tegulae rule out *S. pallidipennis* Cockerell. *S. divergens* Brauns I know only in the male; it has the face narrow; the flagellum dusky reddish orange beneath; tarsi dark, hind legs very slender; basal nervure falling short of nervulus; second submarginal cell receiving recurrent nervures about equally distant from base and apex; mandibles strongly bidentate; first tergite elevated, strongly convex in lateral profile, with a deep suture between it and second; mesonotum coarsely punctured; area of metathorax dull. Found by Brauns at Willowmore. Evidently this is related to *S. subincertus*, but I think it can not be its male. *S. glaberrimus* Friese, among other characters, has a very much larger and darker stigma.

Scrapter merescens, n. sp.

Female.—Length 8–9 mm; black, shining, the mesonotum closely punctured and not highly polished; pubescence scanty, not red on thorax above; the abdomen without hair-bands, the hair at apex black. Clypeus closely and finely punctured; mandibles black, supraclypeal area polished; face broader than long; antennae black, rufescent apically beneath; wings dusky, with brown nervures, stigma rather slender, dark brown; second submarginal cell long, receiving recurrent nervures far from base and apex; basal nervure falling short of nervulus; tibial scopa pale, not bicolored.

Considerably smaller than *S. braunsianus*

[1] Received August 28, 1944.

Friese and distinguished from *S. leonis* Cockerell by the duskier wings and the absence of red hair on the scutellum, as well as the broader head. The mesonotum is entirely different from that of *S. glaberrimus* Friese. It is smaller than *S. fuscipennis* Friese, without the bicolored scopa. *S. fuscipennis* is described from "Kapland," without precise locality.

Cape Province: Worcester, September, and August 31, 1928. (R. E. Turner.) Seven females. There is a single male, taken at Worcester by Turner in the latter part of August 1928, which should apparently belong to this species, but the wings are only faintly brownish, and the long hair on the posterior part of the thorax above is light yellow, contrasting with the pure white hair of the mesonotum. The legs are black. This is much larger than *S. glaberrimus* Friese, and the stout abdomen does not have the constriction, between the first and second tergites, so conspicuous in *S. glaberrimus*.

Scrapter macrocephalus Cockerell is very much like *S. merescens* but is easily distinguished by the light hair at end of abdomen and the highly polished scutellum.

Scrapter sinophilus, n. sp.

Male (type).—Length about 9 mm; black, with the tarsi light yellow, dark at end; pubescence long and white, varying to red on thorax above; face densely covered with pure white hair; mandibles black; flagellum long, dusky reddish beneath; face dull; mesonotum dullish, finely punctured, more shining posteriorly; area of metathorax dull; tegulae small, very dark brown; wings hyaline, stigma dusky reddish, nervures pale brown; basal nervure falling far short of nervulus; second submarginal cell very long, receiving recurrent nervures far from base and apex; hind legs long and slender, the spurs very long; abdomen rather slender, moderately shining, the depressed hind margins of tergites colorless; first tergite narrowly reddened apically; middle tergites with thin hair-bands.

Female.—Similar, but stouter, with the legs all black, and the hyaline hind margins of tergites much broader; wings more brownish; flagellum red beneath; hair of scutellum clear ferruginous, of mesonotum whitish, but not clear white.

Cape Province: Mossel Bay, August 1932, 12 males, 4 females (R. E. Turner, 18).

In my key this runs (male) near *S. flavitarsis* Cockerell but is larger, with dark antennae. In Friese's table the male runs nearest to the much smaller *S. glaberrimus* Friese.

The female runs in Friese's table to *S. longulus* Friese, but that is quite different, as shown in Stylops, March 1933. *S. longulus* differs by the extremely broad head and the basal prominence on third abdominal sternite of the male.

Scrapter flavipes Friese

Seven from Umtata, Transkei, February–March 1923; 10 from Weenen, Natal, January 1925. The first taken by R. E. Turner (his 17), the others by H. P. Thomasset. The sexes differ in the marking of the abdomen, so that they might be taken for different species. In the females, the short black vertical mark at each side of the red second tergite is characteristic. The types came from Zululand.

Scrapter flavostictus Cockerell

Natal: Van Reenen, Drakensberg, December 1926 and March 7, 1927, 9 males, 11 females (R. E. Turner, 15).

Scrapter brunneipennis, n. sp.

Male.—Length about 8 mm, anterior wing 6.3 mm; black, shining, the head and thorax with long white hair; mandibles faintly reddish apically; face with very long white hair; antennae long, the flagellum obscurely reddish beneath; mesonotum shining, with large punctures, and a strong median sulcus; scutellum highly polished; area of metathorax entirely dull; tubercles black; tegulae very dark brown; wings rather dilute fuliginous, stigma dusky brown; lower section of basal nervure not arched (as it is in *S. caffra* Brauns); second submarginal cell of the shorter type (style of *S. perpunctatus* Cockerell); first recurrent nervure ending a little nearer base of second submarginal cell than second to apex; legs black, tarsi pale reddish, fron tibiae pale yellowish in front, middle tibiae pale at base and apex; abdomen very stout, black, without hair-bands, the apex with scanty dark hair.

Cape Province: Mossel Bay, August 1932 (R. E. Turner).

Easily known from *S. sinophilus* by the shining mesonotum with very strong punctures, pale reddish tarsi, much shorter second submarginal cell, and abdomen without hair-bands. Known from *S. leonis* Cockerell by the pale reddish stigma and very brown wings. The wings are much brower and the stigma is not so red as in *S. subincertus*. *S. perpunctatus* Cockerell, known only from the female, is very similar, but the stigma is larger and darker, and the area of metathorax quite different, with conspicuous raised ridges. *S. caffra* Brauns, of which I have seen the male, differs in venation and otherwise. There remains the briefly described *S. fuscipennis* Friese, known only in the female, 10 mm long. It is not impossible that our insect is the male of *S. fuscipennis*.

Scrapter sphecodoides Friese

Cape Province: Matjesfontein, October 16–21, 1928 (R. E. Turner). I have specimens from Cape Town collected by Peringuey.

Genus **Notomelitta** Cockerell
Notomelitta rufocincta, n. sp.

Male (type).—Length 12–12.5 mm, rather slender, with shining abdomen as in *N. politissima* Cockerell, which it closely resembles, but it differs by having the second and third abdominal segments, above and below, bright ferruginous, the tergites each with a very broad triangular black mark, based posteriorly; the first tergite is sometimes slightly reddish at sides, and the fourth sternite is largely reddish, while the fourth tergite is red at the extreme (usually covered) base. There is a variable amount of black hair on the thorax above, especially on the anterior part of the scutellum. The second submarginal cell has its outer side vertical, but the inner very oblique. The abdominal hair-bands are narrower than in *N. politissima.*

Female.—Length about 13 mm. Abdomen colored as in male. Hind basitarsi extremely broad, reddish, with mainly black hair, but white hair in front, and long white hairs at base. The front tarsi are not unusually long.

Natal: Van Reenen, Drakensberg, December 1926 (one male, January 1927). Five males, seven females. In my key in Ann. Mag. Nat. Hist., April 1934, this runs to *N. politissima.* In the key based on venation it runs near to *N. politissima,* but the third submarginal cell is less produced at end. In my key to *Melitta* in Ann. Transvaal Mus. **17**: 76. 1935, it runs nearest to *M. longicornis* Friese, which differs by the dullish, unbanded abdomen. All the specimens were collected by R. E. Turner.

ZOOLOGY.—*A new species of hoplonemertean* (Paranemertes biocellatus) *from the Gulf of Mexico.*[1]

Wesley R. Coe, Osborn Zoological Laboratory, Yale University, and Scripps Institution of Oceanography, University of California. (Communicated by Waldo L. Schmitt.)

Among the nemerteans collected on the intertidal sand flats near Biloxi, Miss., were three specimens of an undescribed species of *Paranemertes* Coe. Only five other species of that genus have been previously reported; four of these were found on the Pacific coast of North America and one on the coast of South Africa. This new species presents such morphological deviations from the others that their description will supplement in some degree the available knowledge of nemertean morphology.

Individuals of this new species, which may be known as **Paranemertes biocellatus** resemble those of *P. californica,* found on the Pacific coast, in size and general appearance but differ in having the proboscis sheath nearly as long as the body, in the character of the proboscis armature, in size and shape of ocelli, and in other morphological details. The species also resembles *Amphiporus bioculatus* McIntosh in having a narrow, pointed head and a single pair of ocelli but differs widely in most other characteristics.

[1] Received October 5, 1944.
Contributions of the Scripps Institution of Oceanography, New Series No. 241.

DESCRIPTION

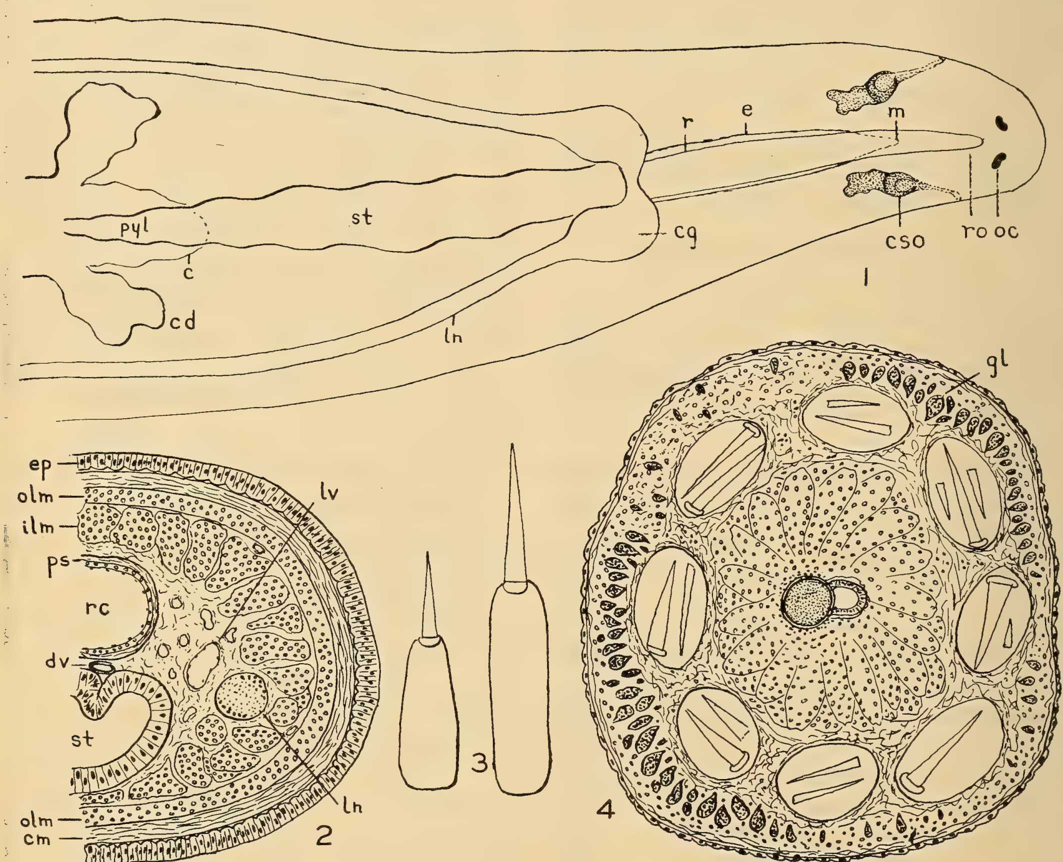
Body long, moderately slender, pointed anteriorly and much flattened in intestinal region. Shape and general appearance similar to the published figure of *P. californica* (Coe, 1904, pl. 15, fig. 2). Size when mature 60 to 120 mm or more in length and 2 to 4 mm in width.

Color.—Although no record is available as to the details of coloration in life, the specimens a short time after preservation were translucent, with a pale opalescence and tinges of green and rose anterior to the intestinal region. The rest of the body varied from pale to deep green, fading to colorless near the posterior extremity. The green color was confined mainly to the intestinal diverticula. The general appearance in life must have been similar to the colored figure of *P. californica* published by Coe (1904, pl. 15, fig. 2), although the colors were presumably paler than those shown in that figure.

After clearing in oil the tissues become pale yellowish with the exception of the intestinal diverticula, which retain their green pigmentation.

Ocelli.—The tip of the head is provided with a single pair of large, kidney-shaped, intensely black ocelli. These are always conspicuous after clearing in oil, and presumably also in life, although they are situated deep in the tissues of the head. In a specimen about 100 mm in length each ocellus measures 0.009 mm in length and 0.006 mm in diameter (Fig. 1).

Proboscis.—This species differs from the other described species of the genus in having



Paranemertes biocellatus, n. sp.: Fig. 1.—Diagram of organ systems in anterior end of body after clearing in oil; *c*, caecum; *cd*, caecal diverticulum; *cg*, cerebral ganglion; *cso*, cerebral sense organ; *e*, esophagus; *ln*, lateral nerve cord; *m*, opening of mouth into rhynchodeum; *oc*, ocellus; *pyl*, pylorus; *r*, rhynchodeum; *ro*, rhynchodeal opening on ventral surface of head; *st*, stomach. Fig. 2.—Portion of transverse section of body posterior to brain, showing the two layers of longitudinal muscles; *cm*, circular muscular layer; *dv*, dorsal blood vessel; *ep*, epithelium of body wall; *ilm*, inner layer of longitudinal muscles; *ln*, lateral nerve cord; *lv*, lateral blood vessel, with branches in surrounding parenchyma; *olm*, outer layer of longitudinal muscles; *ps*, proboscis sheath; *rc*, rhynchocoel; *st*, stomach. Fig. 3.—Central stylet and basis from two individuals. Fig. 4.—Diagram of transverse section through septum of proboscis, showing, in center, stylet basis and canal leading from anterior to posterior proboscis chamber, and longitudinal musculature surrounded by eight pouches of accessory stylets; *gl*, wreath of pigmented gland cells.

the proboscis sheath nearly as long as the body. The proboscis is armed with a slender, nearly cylindrical basis and with four or eight pouches of accessory stylets (Fig. 4). In one specimen the basis was of nearly equal diameter throughout the entire length and truncated posteriorly, while in another specimen it was slightly enlarged posteriorly (Fig. 3). In an individual exceeding 100 mm in length the basis was four times as long as its diameter, measuring 0.24 mm in length and 0.052 to 0.06 mm in diameter. In an individual 45 mm long the basis was only 0.016 mm long and 0.05 mm wide anteriorly and 0.07 mm posteriorly. The stylets are approximately two-thirds as long as the bases. The latter are deep brown in color. There are 12 proboscidial nerves.

Musculatures.—In this species, as in the others of the genus, the longitudinal musculature in the anterior portion of the body is divided into two distinct layers, as described and figured by Coe (1904, 1905) for *P. californica.* Of these, the outer layer is approximately equal to the circular layer in thickness, while the inner layer averages several times as thick. The two layers are separated by a thin sheet of connective tissue carrying numerous blood vessels and branches of the lateral peripheral nerves (Fig. 2). In the brain region this inner musculature closely invests the brain and esophagus and so nearly fills all the space between these organs and the outer muscular walls that the cephalic parenchyma is reduced to small patches. This inner longitudinal musculature is continuous with the proboscis insertion musculature.

In the region of the pylorus the sheet of connective tissue separating the two longitudinal musculatures becomes thicker but diminishes again anterior to the intestinal region, and the two layers become united more posteriorly. The inner portion can, however, be recognized by its larger fibers far back in the intestinal region.

Digestive system.—As shown in Fig. 1, the mouth opens by a long slit into the rhynchodeum some distance posterior to the rhynchodeal opening when the proboscis remains in its normal position within the body. The slender esophagus leads to the elongated stomach and thence to the slender pylorus, which opens into the midgut somewhat farther behind the brain than the distance from brain to tip of head. The caecum is remarkably short and bears but a single pair of diverticula (Fig. 1). The paired midgut diverticula are as in other species.

Blood and nephridial systems.—In the two specimens cut into serial sections the blood vessels were much contracted, both in the head and throughout the body. Near its origin from the cephalic anastomosis of the lateral vessels, the dorsal vessel passes into, but not through, the wall of the proboscis sheath for a short distance and then continues on the ventral side of the sheath to the posterior end of the body. There are numerous connections between the dorsal and lateral vessels.

In neither of the two specimens are the nephridial canals well preserved, nor could the efferent ducts be demonstrated. The same difficulty was encountered in two specimens of *P. californica* (Coe, 1905), although in a third specimen both the canals and the efferent ducts were conspicuous (Coe, 1940).

Nervous system.—The brain is situated farther back from the anterior end of the head than in most hoplonemerteans (Fig. 1). The four ganglia and their dorsal and ventral commissures are of the usual hoplonemertean type. The 12 proboscidial nerves are large and well differentiated from the interneural plexus. The lateral nerves unite posteriorly on the dorsal side of the rectum.

Cerebral sense organs.—These organs, with their sensory and glandular components, are relatively small, elongated structures situated far anterior to the brain. They are connected with the exterior by a pair of ciliated canals leading anterolaterally to the lateral surfaces of the head (Fig. 1).

Reproductive organs.—The gonads are of the usual hoplonemertean type, alternating more or less regularly with the intestinal diverticula. The gametes were not fully ripe in December.

Habitat.—These specimens were found burrowing in intertidal sand flats at Deer Island and at two other localities on the shore at Biloxi, Miss., by M. W. Williams. Cotypes, U.S.N.M. 20641.

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ICHTHYOLOGY.—*A new species of cichlid fish of the genus* Petenia *from Colombia.*[1] LEONARD P. SCHULTZ, U. S. National Museum.

Recently, while studying the cichlid fishes of Venezuela and attempting to identify other specimens from South America in the collections of the U. S. National Museum that had never been identified or reported upon, I came across two fishes that appear to belong to a new species of the genus *Petenia*. A few years ago Dr. George S. Myers, when in charge of the fish collections in the National Museum, had examined these two specimens and noted that they seemed to represent a new species, but he did not work up a description or separate it from other members of the genus. In view of Dr. Myers's preliminary notation, I take great pleasure in naming this new species in his honor.

Genus **Petenia** Günther

Petenia Günther, Catalogue of the fishes in the British Museum **4**: 301. 1862. (Genotype: *Petenia splendida* Günther.)

Petenia myersi, n. sp.

Holotype.—U.S.N.M. no. 120533, a specimen 137 mm in standard length, collected by Brother Nicéforo María, in the Río Dedo, tributary of the Río Orteguaza, near Florencia (Amazon system), Colombia.

Paratype.—U.S.N.M. no. 120534, a specimen 65 mm in standard length with same data. This fish is in poor condition, with injured snout, and was preserved in a hunchback position. Measurements, therefore, may not be very reliable, although I tried to straighten the specimen.

Description.—Measurements are expressed in hundredths of the standard length, first for the holotype, then for the paratype in parentheses. Standard length in mm 137 (65).

Length of head 37.9 (40.0); greatest depth of body 43.1 (46.9); length of snout 14.6 (13.1); diameter of eye 8.61 (11.5); width of interorbital space 10.2 (9.23); least width of preorbital 4.89 (4.62); postorbital length of head 15.7 (16.9); snout tip to rear end of maxillary 24.1 (– –); snout to nostril 10.9 – –); eye to nostril 3.65 (3.08); length of caudal peduncle 17.7 (14.2); least depth of caudal peduncle 14.2 (13.8); length of fifth dorsal spine 12.4 (16.5); length of last dorsal spine 12.4 (– –); longest ray of pelvics 31.0 (31.5); longest ray of pectorals 21.5 (24.9); distance out from base that caudal fin is scaled 13.9 (11.5); longest caudal fin ray 25.5 (26.2).

The following counts were made, respectively: Dorsal rays XV,13 (XV,13); anal rays V,9 (V,9); pectoral rays 15-15 (15-15); pelvic rays, I,5-I,5 (I,5-I,5); branched caudal fin rays 14 (14); scale rows below lateral line 32 (32); scales from dorsal origin to lateral line 6 (6); scales from pelvic base to lateral line 12 (12); pores in lateral line 18+13 (18+11); scales from base of last dorsal spine to lateral line and on base of dorsal 5+2 (5+2); zigzag row of scales around caudal peduncle 20 (20).

Body compressed, greatest depth at origin of dorsal fin $2\frac{1}{2}$ in standard length; caudal peduncle a little longer than deep; head $2\frac{3}{4}$ in standard length; eye 1.9 in snout and $4\frac{1}{2}$ times in head; interorbital equal to snout tip to nostril and $3\frac{3}{4}$ in head; snout tip to rear of maxillary 1.6 in head, maxillary curving downward to under middle of eye; premaxillary greatly protractile, the premaxillary process reaching to a vertical through middle of operculum; gill rakers short, stubby, about 1+9; teeth in a villiform band on both jaws, the outer rows enlarged, curved, conical, caninelike teeth and widely spaced, largest forward; upper and lower lips fleshy, continuous around the end of the jaw without a frenum; scales large, ctenoid, forward on top of head to middle of interorbital space; cheeks and operculum scaled, except the preopercular edge posteriorly, which is naked; spinous dorsal with a row of scales at its base posteriorly, then several rows of scales on soft dorsal, mostly on membranes between the rays; base of anal fin similarly scaled; caudal fin scaled out for half its length; soft rays of vertical fins prolonged; soft rays of pelvic fins filamentous and extending to opposite base of first few anal spines; pectoral fin rounded, reaching just past the middle black vertical bar; nostril twice nearer eye than tip of snout.

Color (in alcohol).—Light brownish, darker above, paler ventrally; a black vertical bar beginning at dorsal origin, passing through eye, thence downward just behind maxillary to un-

[1] Published by permission of the Secretary of the Smithsonian Institution. Received April 13, 1944.

TABLE 1.—FIN-RAY COUNTS RECORDED FOR THE SPECIES OF PETENIA

Species	Dorsal							Anal					
	Spines			soft				Spines			soft		
	XV	XVI	XVII	10	11	12	13	V	VI	VII	8	9	10
splendida....	x[1]	x	—	—	—	x	x	x	x	—	x	x	x
spectabilis...	x	—	—	—	—	x	x	—	x	—	—	x	x
kraussii.....	4	15	1	4	16	—	—	—	19	1	5	14	1
myersi......	2	—	—	—	—	—	2	2	—	—	—	2	—

[1] x means that counts were taken from the literature.

derside of head; brownish area on back below front of spinous dorsal fading at lateral line; then a second vertical dark brownish bar from bases of seventh to tenth dorsal spines downward across middle of body to a little in front of anus; third vertical bar extending downward from front of soft dorsal and fourth at and a little behind rear of soft dorsal; fifth bar occurring at rear of caudal peduncle, narrowly separated from a dark bar at base of caudal fin; a more or less indistinct and broken lateral band from behind eye to caudal peduncle on the holotype but lacking on the paratype; pelvics blackish; other fins appearing to be plain in color at the present time.

Remarks.—The members of the genus *Petenia* may be recognized by the combination of the following characters: Premaxillary extremely protractile, with the ascending process reaching from behind the orbits to a vertical line through middle of operculum, this premaxillary process nearly as long as length of head; lips thick, fleshy, without a frenum; maxillary much exposed, only partly slipping under preorbital, and extending to a vertical line through middle of eye; in the outer row teeth enlarged, curved, conical, and widely spaced, followed by a band of villiform teeth inside; lateral line interrupted, continuing on middle of caudal peduncle; the upper lateral line separated from base of dorsal fin by 4 or more full-sized scales; lateral line scales same size as those above and below; gill rakers short, thick, about 9 or 10 on lower part of first arch; preorbital narrower than diameter of eye; nostril closer to eye than tip of snout; bases of soft

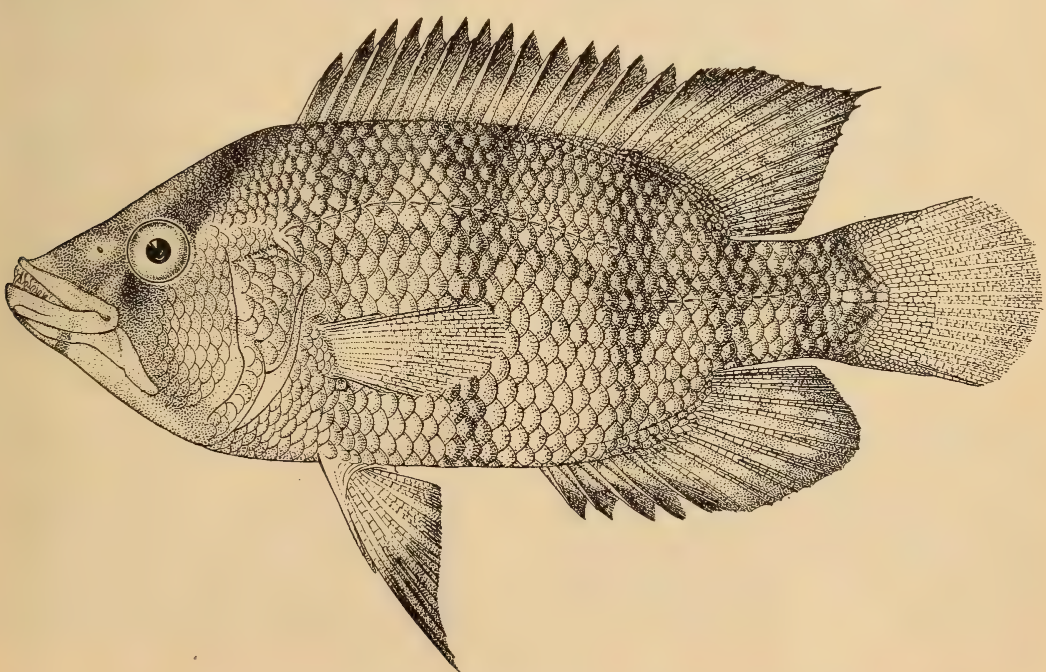

FIG. 1.—*Petenia myersi*, n. sp.: Holotype (U.S.N.M. No. 120533). Drawn by Mrs. Aime N. Awl.

rays of median fins scaled; gill membranes joined but forming a wide, free fold across isthmus; scales ctenoid; dorsal rays XV or XVI, rarely XVII, 10 to 13; anal V or VI (rarely VII), 8 to 10. See Table 1 for counts made on the species of *Petenia.*

This new species may be distinguished from all others referred to the genus *Petenia* by the following key:

1*a*. Pores in lateral line 18 to 21+15 to 20; 6 to 8 black blotches along midaxis, first on opercle, then 5 or 6 on midaxis of body, the last an ocellated spot on base of upper rays of caudal fin; head and median fins black spotted; scale formula—6 from dorsal origin to lateral line, 38 to 41 from upper opercular opening to midcaudal fin base below lateral line, and 15 to 20 from pelvic origin to lateral line; dorsal rays XV or XVI, 12 or 13; anal V or VI, 8 to 10; head $2\frac{1}{2}$ to 3, depth $2\frac{1}{2}$ to $2\frac{2}{3}$ in standard length .... *Petenia splendida* Günther[2]

1*b*. Pores in lateral line 18 to 20+9 to 13; scale formula—5 or 6+29 to 32+11 to 13; color pattern of blackish vertical bars or not more than 3 black blotches along midaxis; head $2\frac{1}{3}$ to $2\frac{2}{3}$ in standard length.

2*a*. Three black blotches along midaxis, the first on opercle, sometimes joining with a black blotch on shoulder at beginning of lateral line, the second in middle of length below lateral line, the third an ocellated spot on base of upper caudal fin rays; no black vertical bar through eye; distance from rear base of anal fin to midcaudal fin base 1.1 or 1.2 in least depth of caudal peduncle; depth $2\frac{1}{3}$ to $2\frac{3}{4}$ in standard length.

3*a*. Greatest depth $2\frac{1}{3}$ to $2\frac{3}{4}$ in standard length; last dorsal spine $2\frac{2}{5}$ to $2\frac{3}{5}$ in head; opercular and shoulder spots usually prominent on adults, less so or absent on young; about 6 usually double darkish vertical bars on body and vertical fins somewhat black spotted; dorsal rays XV or XVI, 10 or 11; anal VI, rarely VII, 8 or 9; scales 6+29 to 30+11 to 13; pores in lateral line 19 or 20+9 to 11 .... *Petenia kraussii* Steindachner[3]

3*b*. Greatest depth 2 in standard length; last dorsal spine $2\frac{3}{10}$ in head; shoulder spot and opercular spot absent; vertical fins not spotted; vertical dark bars lacking; dorsal rays XV, 12 or 13; anal rays VI, 9 or 10; scales 5 or 6+30+11 or 12; pores in lateral line 19 or 20+11 to 13............................. *Petenia spectabilis* (Steindachner)[4]

2*b*. No ocellate black spot on caudal fin base; a blackish bar from dorsal origin through eye to underside of head; a second blackish bar from middle of base of spinous dorsal to belly in front of anus, a third one from front of soft dorsal, one or two more bars on caudal peduncle, and another blackish bar on base of caudal fin; pelvics black; vertical fins probably black spotted; no black blotches along midaxis of body, as in 2*a;* a more or less indistinct darkish lateral streak along midaxis on adult, absent on small specimen; length of caudal peduncle about 0.8 or 0.9 in its least depth or longer than deep: least depth $2\frac{1}{5}$ to $2\frac{2}{5}$ in standard length; dorsal rays XV, 13; anal rays V, 9; scales 6+32+12; lateral line pores 18 or 19+11 to 13............... *Petenia myersi*, n. sp.

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[2] I have observed the following references to this species: *Petenia splendida* Günther, Cat. Fishes Brit. Mus. **4**: 301. 1862 (Lake Petén).—Eigenmann and Bray, Ann. New York Acad. Sci. **7**: 615. 1894 (Lake Petén).—Regan, Ann. Mag. Nat. Hist. (ser. 7) **16**: 433. 1905 (Lake Petén).—Regan, Biologia Centrali-Americana, Pisces: 29. 1908 (Lake Petén).—Pellegrin, Mem. Soc. Zool. France **16**: 243. 1903 (Lake Petén; Bélize).

[3] I have noticed the following references to this species:

Petenia kraussii Steindachner, Denkschr. Akad. Wiss. Wien **39**: 28, pl. 2, fig. 1, a–b. 1878 (Río Magdalena); **42**: 56. 1879 (Río Cauca); **72**: 130. 1902 (Río Lebrija, trib. Río Magdalena at Santander).—Eigenmann and Bray, Ann. New York Acad. Sci. **7**: 615, 1894 (Río Magdalena).—Pellegrin, Mem. Soc. Zool. France **16**: 244, 1903 (Maracaibo; Río Magdalena).

Cichlosoma kraussi, Regan, Ann. Mag. Nat. Hist. (ser. 7) **16**: 339, 1905 (Baranquilla, Colombia; Venezuela).

Cichlasoma kraussii, Eigenmann, Mem. Carnegie Mus. 9 (1): 207. 1922 (Magdalena and Atrato Basins).—Myers, Stanford Ichthy. Bull. 2 (4): 114. 1942 (Quebrada Sargento, trib. Río Limón, north of Maracaibo, Venezuela).

Astronotus (*Petenia*) *kraussi*, Eigenmann and Eigenmann, Proc. U. S. Nat. Mus. **14**: 69. 1891 (Magdalena system).

In addition, I collected this species in 17 localities in the Maracaibo Basin of Venezuela during 1942.

[4] I have noticed the following references to this species:

Acara (*Petenia*) *spectabilis* Steindachner, Sitzb. Akad. Wiss. Wien **71**: 36, pl. 4. 1875 (Amazon River at Gurupa and Obidos).

Petenia spectabilis Eigenmann and Bray, Ann. New York Acad. Sci. **7**: 615, 1894 (Amazon near Gurupa and Obidos).—Pellegrin, Mem. Zool. Soc. France **16**: 244. 1903 (Pará).

Cichlosoma spectabile, Regan, Ann. Mag. Nat. Hist. (ser. 7) **16**: 339. 1905 (Río Amazon).

Astronotus (*Petenia*) *spectabilis* Eigenmann and Eigenmann, Proc. U. S. Nat. Mus. **14**: 69. 1891 (Gurupa; Obidos).

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